

California High-Speed Train Project



TECHNICAL MEMORANDUM

Access Control for High-Speed Rail Right-of-Way and Facilities

TM 2.8.2

Prepared by: Signed document on file 08 October 10
Maritza Acosta, PE Date

Checked by: Signed document on file 09 October 10
John Chirco, PE Date

Approved by: Signed document on file 11 October 10
Ken Jong, PE, Engineering Manager Date

Released by: Signed document on file _____
Clifford Eby, Program Director Date

Revision	Date	Description
0	11 Oct 10	For Initial Release

Note: Signatures apply for the latest technical memorandum revision as noted above.

This document has been prepared by **Parsons Brinckerhoff** for the California High-Speed Rail Authority and for application to the California High-Speed Train Project. Any use of this document for purposes other than this Project, or the specific portion of the Project stated in the document, shall be at the sole risk of the user, and without liability to PB for any losses or injuries arising for such use.

TABLE OF CONTENTS

ABSTRACT	1
1.0 INTRODUCTION	2
1.1 PURPOSE OF TECHNICAL MEMORANDUM	2
1.2 STATEMENT OF TECHNICAL ISSUE	2
1.3 GENERAL INFORMATION	3
1.3.1 DEFINITION OF TERMS	3
1.3.2 UNITS	4
2.0 DEFINITION OF TECHNICAL TOPIC	5
2.1 GENERAL	5
2.1.1 CHSTP DESIGN PARAMETERS	5
2.2 LAWS, CODES AND NATIONAL STANDARDS	5
2.2.1 49 CODE OF FEDERAL REGULATIONS	6
2.2.2 CPUC GO 95 PART 79	6
2.2.3 CPUC GO 143 RULE 9	7
2.2.4 NATIONAL FIRE PROTECTION ASSOCIATION (NFPA) 130	7
2.2.5 AMERICAN RAILROAD ENGINEERING AND MAINTENANCE OF WAY ASSOCIATION (AREMA)	8
2.3 ASSESSMENT OF CURRENT PRACTICE	9
2.3.1 ACCESS CONTROL ON HIGH-SPEED TRAIN SYSTEMS	9
2.3.2 ACCESS CONTROL IN THE UNITED STATES	11
3.0 ASSESSMENT / ANALYSIS	20
3.1 GENERAL	20
3.2 ACCESS CONTROL INFRASTRUCTURE	20
3.2.1 FENCES	20
3.2.2 WALLS	22
3.2.3 TRAFFIC BARRIERS	22
3.2.4 FENCING AND TRAFFIC BARRIERS IN COMBINATION	22
3.2.5 GATES	22
3.2.6 SIGNAGE	23
3.2.7 VEGETATION CONTROL	23
3.3 ACCESS CONTROL BY TYPE OF HST TRACKWAY	23
3.3.1 AT-GRADE TRACKWAY	24
3.3.2 AT-GRADE TRACKWAY WITHIN HIGHWAY CORRIDOR	24
3.3.3 AT-GRADE TRACKWAY ADJACENT TO CONVENTIONAL RAIL TRANSPORTATION SYSTEMS	24
3.3.4 AT-GRADE TRACKWAY THROUGH HIGH-RISK TRESPASSING AREAS	24
3.3.5 TRACKWAY IN CUT OR FILL (EMBANKMENT) SECTION	24
3.3.6 TRACKWAY ON AERIAL STRUCTURE	25
3.3.7 TRACKWAY ON RETAINED FILL	25
3.3.8 TRACKWAY ON RETAINED CUT (OPEN)	26
3.3.9 TRACKWAY UNDERGROUND (BORED, MINED AND CUT AND COVERED TUNNELS)	26

3.4	ACCESS CONTROL BY TYPE OF FACILITY	26
3.4.1	YARDS AND MAINTENANCE FACILITIES	26
3.4.2	OVERHEAD CATENARY SYSTEM, SIGNAL AND TRACTION POWER FACILITIES	26
3.4.3	PASSENGER STATION.....	27
3.5	ACCESS CONTROL AT OTHER LOCATIONS	27
3.5.1	END OF LINE AND STORAGE TRACKS	27
3.5.2	HIGHWAY OVERPASSES CROSSING HST TRACKWAY.....	27
3.5.3	STREETS DEAD-ENDING AT HST TRACKWAY.....	27
3.5.4	ACCESS ROADS.....	28
3.5.5	MAINTENANCE ROADS.....	28
3.5.6	EMERGENCY EXITS AND EQUIPMENT ROOMS IN TUNNELS	28
3.5.7	DRAINAGE STRUCTURES	28
4.0	SUMMARY AND RECOMMENDATIONS.....	29
5.0	SOURCE INFORMATION AND REFERENCES	31
6.0	DESIGN MANUAL CRITERIA.....	32
6.1	GENERAL	32
6.2	ACCESS CONTROL DEVICES	32
6.2.1	FENCES.....	32
6.2.2	WALLS	33
6.2.3	TRAFFIC BARRIERS	34
6.2.4	FENCING AND TRAFFIC BARRIERS IN COMBINATION	34
6.2.5	GATES.....	34
6.2.6	SIGNAGE	35
6.2.7	VEGETATION CONTROL	35
6.3	ACCESS CONTROL BY TYPE OF HST TRACKWAY	35
6.3.1	AT-GRADE TRACKWAY	35
6.3.2	AT-GRADE TRACKWAY WITHIN HIGHWAY CORRIDOR	36
6.3.3	AT-GRADE TRACKWAY ADJACENT TO CONVENTIONAL RAIL TRANSPORTATION SYSTEMS.....	36
6.3.4	AT-GRADE TRACKWAY THROUGH HIGH-RISK TRESPASSING AREAS	36
6.3.5	TRACKWAY IN CUT OR FILL (EMBANKMENT) SECTION	36
6.3.6	TRACKWAY ON AERIAL STRUCTURE	36
6.3.7	TRACKWAY ON RETAINED FILL	37
6.3.8	TRACKWAY ON RETAINED CUT (OPEN).....	37
6.3.9	TRACKWAY UNDERGROUND (BORED, MINED AND CUT AND COVERED TUNNELS).....	38
6.4	ACCESS CONTROL BY TYPE OF FACILITY	38
6.4.1	YARDS AND MAINTENANCE FACILITIES	38
6.4.2	OVERHEAD CATENARY SYSTEM, SIGNAL AND TRACTION POWER FACILITIES	38
6.4.3	PASSENGER STATION.....	38
6.5	ACCESS CONTROL AT OTHER SPECIAL LOCATIONS.....	39
6.5.1	END OF LINE AND STORAGE TRACKS	39
6.5.2	HIGHWAY OVERPASSES CROSSING HST TRACKWAY.....	39
6.5.3	STREETS DEAD-ENDING AT HST TRACKWAY.....	39
6.5.4	ACCESS ROADS.....	39
6.5.5	MAINTENANCE ROADS.....	40
6.5.6	EMERGENCY EXITS AND EQUIPMENT ROOMS IN TUNNELS	40
6.5.7	DRAINAGE STRUCTURES	40

6.6	ACCESS CONTROL SUMMARY	41
	APPENDICES	43
	APPENDIX A: REGULATIONS AND INDUSTRY STANDARDS ON ACCESS CONTROL FOR TRACKWAY AND FACILITIES	43
	APPENDIX B: ASSESSMENT OF CURRENT PRACTICE ON ACCESS CONTROL FOR TRACKWAY AND FACILITIES	44
	APPENDIX C: SUMMARY OF RECOMMENDATIONS ON ACCESS CONTROL FOR HST RIGHT-OF-WAY AND FACILITIES	45

ABSTRACT

This Technical Memorandum presents the Infrastructure elements recommended for the protection of high-speed train right-of-way and facilities against trespass by unauthorized persons, vandalism, and animal intrusion. It assesses the guidance and regulatory requirements from local and national agencies on access control and summarizes available information on access control methods used by other high-speed train systems and by rail transit operators, including Metropolitan Atlanta Rapid Transit Authority (MARTA) and the San Francisco Bay Area Rapid Transit District (BART), which operate in exclusive, fully access-controlled right-of-way. These will be used as the basis for recommending appropriate infrastructure features for access control for high-speed train trackways and facilities, grouped as follows:

A. High-speed train trackways:

- At-grade
- At-grade within highway corridor
- At-grade adjacent to conventional rail transportation systems
- At-grade through high trespassing risk areas
- Sloped cut or fill
- Aerial structures
- Retained fill
- Retained cut (open)
- Underground (bored, mined and cut and covered tunnels)

B. High-speed train facilities:

- Yard and maintenance facilities
- Signal and traction power facilities
- Passenger station platforms
- Parking structures

C. Access control at other locations:

- End of line and storage tracks
- Highway overpasses crossing or paralleling HST trackway
- Streets dead-ending at HST trackway
- Access roads
- Maintenance roads
- Emergency exits and equipment rooms in tunnels
- Drainage structures

Surveillance and Intrusion Detection Systems are not covered in this technical memorandum. These systems will be developed in other project documents to achieve the requirements of the Safety and Security Plan.

1.0 INTRODUCTION

This Technical Memorandum addresses the infrastructure features (fences, gates, barriers, walls) required for the control of access to the California High-Speed Train right-of-way and facilities.

It considers national and local requirements for access control of rail right-of-way operating at track class 8 and above, as described in Code of Federal Regulations, Part 49 (49 CFR), the California Public Utilities Commission (CPUC) and the National Fire Protection Agency (NFPA). It assesses the state of practice by other high-speed rail systems throughout the world and that of major rapid transit systems in the United States, such as MARTA (Atlanta) and BART (California). These transit agencies operate in fully-controlled, exclusive right-of-way and their access control systems have proven records of safe performance. These discussions are the basis for the criteria recommended for the California High-Speed Train Project.

1.1 PURPOSE OF TECHNICAL MEMORANDUM

The purpose of this Technical Memorandum is to establish design guidelines for the location and type of infrastructure features to be used to prevent unauthorized access to high-speed train trackway and facilities.

1.2 STATEMENT OF TECHNICAL ISSUE

Control of access to the high-speed train right-of-way and facilities is required to ensure the reliability of high-speed train operation and the safety of its patrons, staff and the public. This Technical Memorandum defines the infrastructure elements such as fences, barriers, walls and gates to be provided for the protection of high-speed train properties against unauthorized access by people and animals. These discussions are presented according to the following classifications:

A. High-speed train trackways:

- At-grade
- At-grade within highway corridor
- At-grade adjacent to conventional rail transportation systems
- At-grade through high trespassing risk areas
- Sloped cut or fill
- Aerial structures
- Retained fill
- Retained cut (open)
- Underground (bored, mined and cut and covered tunnels)

B. High-speed train facilities:

- Yard and maintenance facilities
- Signal and traction power facilities
- Passenger station platforms
- Parking structures

C. Access control at other special locations:

- End of line and storage tracks
- Highway overpasses crossing or paralleling HST trackway
- Streets dead-ending at HST trackway
- Access roads
- Maintenance roads
- Emergency exits and equipment rooms in tunnels
- Drainage structures

1.3 GENERAL INFORMATION

1.3.1 Definition of Terms

The following technical terms and acronyms are used in this document.

<u>Aerial Structure:</u>	Trackway section placed on a structure, other than a culvert, which spans above earthen, paved, or water surfaces including roadways, railroads, and water channels.
<u>At-Grade:</u>	At ground surface level; used to describe roadways, river crossings and track alignments.
<u>Barrier:</u>	Also referred to as Intrusion Barrier or Traffic Barrier. A device intended to contain or redirect an errant vehicle by providing a physical limitation through which a vehicle would not typically pass.
<u>Guard Railing:</u>	A metal railing acting as a safety barrier at the side of a freeway, highway or road to prevent errant vehicles from leaving the traveled way.
<u>Intrusion Protection:</u>	Physical structure or space intended to prevent unauthorized personnel, vehicles and wildlife from entering into protected area.
<u>Retained Cut:</u>	Trackway section where tracks are placed uncovered, below existing ground level and where adjacent soil is supported with retaining walls above top of rail elevation.
<u>Retained Fill:</u>	Trackway section where tracks are placed on embankment material contained by retaining walls above existing ground.
<u>Underground Trainway:</u>	Also referred to as Subway. Trackway section where tracks are constructed by the cut-and-cover method or by tunneling method through earth or rock.

Acronyms:

AAR	Association of American Railroads
APTA	American Public Transportation Association
AREMA	American Railway Engineering and Maintenance-of-Way Association
BART	Bay Area Rapid Transit District
Authority	California High-Speed Rail Authority
CHSTP	California High-Speed Train Project
CFR	Code of Federal Regulations
CPUC	California Public Utilities Commission General Order
FRA	Federal Railroad Administration
GO	General Order
HST	High-Speed Train
MARTA	Metropolitan Atlanta Rapid Transit Authority
NFPA	National Fire Protection Association
ROW	Right-of-Way
SNCF	French National Railway Company (Société Nationale des Chemins de fer Français)
SCRR	Southern California Regional Rail Authority
TGV	Train à Grande Vitesse

THSR Taiwan High Speed Rail

UIC International Union of Railways (Union Internationale des Chemins de fer)

1.3.2 Units

The California High-Speed Train Project (CHSTP) is based on U.S. Customary Units consistent with guidelines prepared by the California Department of Transportation (Caltrans) and defined by the National Institute of Standards and Technology (NIST). U.S. Customary Units are officially used in the U.S. and are also known in the U.S. as “English” or “Imperial” units. In order to avoid any confusion, all formal references to units of measure should be made in terms of U.S. Customary Units.

2.0 DEFINITION OF TECHNICAL TOPIC

2.1 GENERAL

The basis for access control requirements is the standards and requirements of 49 CFR, AREMA and relevant CPUC General Orders. In addition, available guidelines on access control methods used by other operating high-speed rail systems (THSR, Shinkansen, and TGV), rapid transit systems in the United States (MARTA and BART), and other rail service providers in California (Caltrain and Metrolink) were assessed and, when appropriate, similar requirements are recommended for the CHSTP.

One of the most relevant documents to the content of this technical memorandum is the Access Control and Intrusion Barriers in the San Francisco Bay Area Rapid Transit (BART) Facilities Standards. These guidelines were often followed when prescribing design criteria for the CHSTP because they achieve FRA and CPUC requirements and because of the following similarities between the BART and the CHST systems:

- Electrified railway operation in exclusive right-of-way
- Perimeter fence throughout trackway and facilities right-of-way
- Access to trackway and facilities other than passenger stations and associated parking facilities is permitted only to authorized personnel under strict regulations
- No at-grade crossings
- Located in California and subject to the local laws and regulations pertaining to access control.

2.1.1 CHSTP Design Parameters

This technical memorandum defines design criteria for type and location of right-of-way fencing, gates, walls, traffic barriers and warning signs to be used to control access into unauthorized areas of California High-Speed Train property.

2.2 LAWS, CODES AND NATIONAL STANDARDS

The following laws, codes and guidelines were reviewed and assessed for applicability in the development of the basis of design for access control of the CHSTP:

- 49 CFR Part 213 – Track Safety Standards
- CPUC GO No. 26-D – Regulations Governing Clearances on Railroads and Street Railroads with Reference to Side and Overhead Structures, Parallel Tracks, Crossings of Public roads, Highways, and Streets.
- CPUC GO No. 75-D – Regulations Governing Standards For Warning Devices For At-Grade Highway-Rail Crossings In The State Of California.
- CPUC GO No. 95 – Rules for Overhead Electric Line Construction.
- CPUC GO No. 143-B – Safety Rules and Regulations Governing Light Rail Transit
- NFPA 130 – Chapter 6 - Trainways
- AREMA - Volume 3, Chapter 12 – Transit and Roadway Considerations

The following sections are excerpts from the documents that were used in the development of the design criteria for control of access for the CHSTP.

2.2.1 49 Code of Federal Regulations

Pertinent sections of 49 CFR follow.

2.2.1.1 Automotive or railroad crossings at grade (CFR Section 213.347)

- (a) There shall be no at-grade (level) highway crossings, public or private, or rail-to-rail crossings at-grade on Class 8 and 9 tracks.
- (b) If train operation is projected at Class 7 speed (125 mph) for a track segment that will include rail-highway grade crossings, the track owner shall submit for FRA's approval a complete description of the proposed warning/barrier system to address the protection of highway traffic and high-speed trains. Trains shall not operate at Class 7 speeds over any track segment having highway-rail grade crossings unless:
 - (1) An FRA-approved warning/barrier system exists on that track segment; and
 - (2) All elements of that warning/barrier system are functioning.

2.2.1.2 Right-of-Way (CFR Section 213.361)

The track owner in Class 8 and 9 shall submit a barrier plan, termed a "right-of-way plan," to the Federal Railroad Administration for approval. At a minimum, the plan will contain provisions in areas of demonstrated need for the prevention of:

- (a) Vandalism;
- (b) Launching of objects from overhead bridges or structures into the path of trains; and
- (c) Intrusion of vehicles from adjacent rights of way.

2.2.2 CPUC GO 95 Part 79

Part 79 of CPUC GO 95 was specifically written for third rail construction and therefore is not considered to be applicable to high-speed rail. The document's descriptions related to fencing, gates and warning signs were used as the basis for preliminary guidance to develop the access control requirements given in this Technical Memorandum.

2.2.2.1 Fencing (Rule 79.4)

A. At Ground Level

Fence construction shall be designed, installed and maintained in such manner as to deny access over, under or through the fencing to all but authorized persons.

B. Material and Height

Fencing material shall be of galvanized steel, woven mesh or links (commonly known as chain-link or cyclone fencing), extending from ground level to a minimum height of seven feet. Above said 7 foot height, there shall be installed an inclined extension of not less than 12 inches, to which shall be attached no fewer than three strands of barbed wire, with said extension being inclined 45° away from the fenced facilities wherever possible.

C. Barrier Protection of Fencing

Wherever the rights-of-way and its fencing are adjacent to thoroughfares or highways (such as in, but not limited to, highway median strips) suitable barriers shall be at all times present between the fencing and the thoroughfare or highway in order to prevent vehicular contact with or damage to the fencing.

D. Gates

Gates for access to the fenced rights-of-way shall be provided for the entrance of emergency vehicles and equipment at approximately one-half mile intervals along the rights-of-way, said gates to be of a design and maintained in a manner compatible with the fencing specified in Rule 79.4-A and Rule 79.4-B.

2.2.2.2 Warning Signs (Rule 79.5)

At every gate, at each station or passenger loading platform, and at intervals of not more than 500 feet along each fence enclosing the rights-of-way, a sign or signs bearing the words "Danger", "Electric Third Rail" and "Keep Away" in letters at least 3 inches in height, shall be installed. The sign or signs may carry other information relative to the hazard present, but these three items shall be in type of larger size than the type of the additional items.

2.2.3 CPUC GO 143 Rule 9

This CPUC General Order was specifically written for Light Rail Transit (LRT). However, the content related to traffic barriers along a right-of-way that is adjacent to a highway may be relevant to the CHSTP.

2.2.3.1 Standards for the Installation of Barriers (Rule 9.02)

When the separate right-of-way of the LRT system occupies the median of a divided arterial highway with fully controlled grade-separated access or is contiguous to such highway, Caltrans' standard barriers of the following types shall be installed under the conditions indicated:

Distance from the Center Line of Track to Edge of Nearest Travel Lane on Roadway	Type of Barrier
36 feet or less	Rigid concrete barrier at least 32 inches in height above the roadway
Greater than 36 feet up to 45 feet	Rigid concrete barrier as specified above or semi-flexible metal barrier (thrie, W, box or other comparable beam) at least 33 inches in height above the roadway.

2.2.3.2 Installation of Curbs, Fences, and Barriers (Rule 9.03)

Concrete curbs, fences, or barriers shall be installed along sections of separate right-of-way of an LRT system when there is a likelihood that motor vehicles or pedestrians may leave the travelled way of any nearby street or highway and encroach onto mainline track.

2.2.4 National Fire Protection Association (NFPA) 130

The following sections of NFPA Chapter 6 – Trainways prescribe requirements for locations of means egress, emergency access and warning signage along underground, surface and elevated guideway.

The distance between exits along underground guideway is prescribed in subsection 2.2.4.1. The locations of these exits are relevant to the subject of this technical memorandum for vulnerable areas along the CHST guideway that need to be protected against unauthorized access. Subsections (2.2.4.2 and 2.2.4.3) describe requirements for access roads, gates and signage.

2.2.4.1 Means of Egress Underground

Number and location of means of egress route: Within underground or enclosed trainways, the maximum distance between exits shall not exceed 762 m (2,500 ft).

Cross-passageways: Cross-passageways shall be permitted to be used in lieu of emergency exit stairways to the surface where trainways in tunnels are divided by a minimum of 2 hour-rated fire walls or where trainways are in twin bores. Cross-passageways shall not be further than 800 ft apart and not further than 800 ft from the station, tunnel portal, or ventilation inlet.

2.2.4.2 Surface and Elevated Emergency Access

Surface trainways: If security fences are used along the trainway, access gates shall be provided in security fences, as deemed necessary by the authority having jurisdiction.

Access gates shall be a minimum of 1120 mm (44 in) wide and shall be of a hinged or sliding type.

Access gates shall be placed as close as practical to the portals to permit easy access to tunnels.

Information that clearly identifies the route and location of each gate shall be provided on the gates or adjacent thereto.

Elevated trainways: Access to the trainway shall be from stations or by mobile ladder equipment from roadways adjacent to the trackway.

If no adjacent or crossing roadways exist, access roads at a maximum of 762 m (2,500 ft) shall be required.

If security fences are used along the trackway, access gates shall be provided as deemed necessary by the authority having jurisdiction.

2.2.4.3 Warning Signs

Warning signs shall be posted on entrances to the trainway (e.g., station platforms and portals), on fences or barriers adjacent to the trainway, and at such other places where non-transit authority might trespass.

The warning signs shall clearly state the hazard (e.g., DANGER HIGH VOLTAGE - 750 VOLTS) with letter sizes and colors in conformance with NFPA 70 and Occupational Safety and Health Administration (OSHA) requirements.

2.2.5 American Railroad Engineering and Maintenance of Way Association (AREMA)

The following subsections are excerpts from AREMA Volume 3, Chapter 12 – Transit and Roadway Considerations Section 3.2.2 - Safety/Security (2008).

2.2.5.1 Fences

The principal means of securing track and right-of-way from intrusion that falls within the responsibility of the track and roadway designer is fencing. Public and patron safety is achieved with respect to track and right-of-way by keeping unauthorized people away from tracks and trains by means of barriers, principally fences.

Right-of-way fence types should be coordinated with security personnel to establish the need, type, height, and whether or not barbed wire or concertina wire topping is needed. Fence requirements should also be coordinated with the project architect, owner, and the public, to select styles that are aesthetically pleasing, particularly at stations and other locations of high visibility. Right-of-way fences are commonly placed on the property lines. Clearance between tracks and fences or walls should be sufficient to provide a safe refuge from passing trains.

2.2.5.2 Gates

Gate locations and their control (locks) should be coordinated with all disciplines that will use them for maintenance access including signals and traction power. Gate locations and keys to locks should be coordinated with local fire and police agencies that will use the gates for emergency access. For shared use corridors that are fenced, gate access must be coordinated with the railroad and procedures established for control of access through a single “dispatcher.”

2.2.5.3 Pedestrian Crossings

Pedestrian safety when crossing tracks is of paramount importance. Overpasses are preferred to underpasses for patron security. If underpasses are used they must be well lit and be considered for CCTV monitoring. Grade crossings should be ADA compliant and be well lit if night use is

expected. Installation of gates, flashing lights and ringing bell warning systems should be considered.

2.2.5.4 Signage

Ample signage should be provided along rights-of-way whether fenced or unfenced, at gates and at grade crossings to warn people of the perils they face near active, particularly electrified, tracks.

Additional safety/security guidelines are provided in the following APTA publications:

- 1981 Guidelines for Design of Rapid Transit Facilities; and
- Transit Security Guidelines Manual.

2.2.5.5 Fencing for Heavy Rail Systems

Heavy rail transit systems should prohibit all access to their rights-of-way. Access to the right-of-way should be controlled by locked gates. Unless grade separation is provided by an elevated structure, tunnel or walls over six (6) feet in height, the right-of-way should be fenced.

Chain link fence at least six (6) feet high should be used as the basic security fence with other types of fence that provide similar or greater protection from intrusion used where appropriate. Consideration should be given to installing intrusion detection on all fencing. Where highway vehicles operate near transit rights-of-way, appropriate barriers to prevent their intrusion into the right-of-way should be provided.

A New Jersey style barrier is recommended for areas where highway vehicles operate parallel to transit tracks. The height of the barrier should be based on the type of traffic. Barriers five (5) feet high have been used on roads with high speed truck traffic. The barrier should not be less than three (3) feet high. The barrier should be topped with a six (6) foot high chain link fence equipped with an intrusion detection system that automatically and instantaneously notifies both train control and transit agency security forces of any intrusion.

2.3 ASSESSMENT OF CURRENT PRACTICE

The following sections evaluate the access control methods used by several operating high-speed train systems and by several passenger rail and rapid transit providers in the United States that operate in exclusive, grade separated, and fully access controlled right-of-way.

2.3.1 Access Control on High-Speed Train Systems

This section summarizes current practices for access control of operating high-speed train systems.

2.3.1.1 European Technical Specifications of Interoperability (TSI)

- Safety fences are installed along the entire HST line to control access, prevent trespassing, and avoid inadvertent entry by railway staff.
- Entrance to restricted areas is only permitted to specifically trained staff.
- Every access to restricted areas is signaled to the command center.
- The following is a list TSI requirements on access control and excerpts from the pertaining sections:
 - INF_ 4.2.22 - Access to or intrusion into line installations: So as to limit the risk of collision between road vehicles and trains, high-speed lines of category I shall not have level crossings opened to road traffic. On lines of categories II and III national rules apply. Other measures to deter access or undesirable intrusion by persons, animals or vehicles into the railway infrastructure domain are the subject of national rules.
 - TUN_4.2.2.2 - Prevent unauthorized access to emergency exits and equipment rooms: For equipment rooms and emergency exits, physical systems, e.g., locks shall be used to

prevent unauthorized access from outside; from inside, it shall always be possible to open the doors for evacuation.

- TUN_4.2.2.11 - Access for rescue services: Rescue services shall be able to enter the tunnel in the case of an incident, via the tunnel portals and/or appropriate emergency exits. These access routes shall be at least 2.25 meters wide and 2.25 meters high. The emergency plan shall describe those facilities dedicated as access routes. If road accessibility is required in the emergency plan, it should be as close as possible to the planned rescue area. Alternative means of access shall be described in the emergency plan.

2.3.1.2 Spain: Administración de Industrias Ferroviarias (ADIF)

- 2.5 meter high perimeter fences are constructed along both sides of the HST line to prevent unauthorized access and vandalism.
- Some aerial structures are equipped with screens designed to prevent collision of birds with trains.
- Areas where the HST line traverses under highway overpasses, 2.5 meters high solid steel plate barriers are required on both sides of the highway above the HST.
- Access gates at 500 meter intervals.

2.3.1.3 Central Japan Railway (Shinkansen)

- Right-of-way is protected from unauthorized entry of humans and animals by fences installed along all at-grade sections.
- Intrusion detection system consisting of fiber-optic cable laid down along a sidewalk adjacent to the fenced trainway is used to protect Shinkansen trainway. If obstacles (freight trains, cars etc) enter from other than the Shinkansen side, such entering is detected when the cable breaks and an emergency stop signal is sent from the automatic train control system to the relevant train for stop.
- There is no regulation of service/access roads along Shinkansen lines. In many cases temporary access roads for Shinkansen construction works are later converted to public roads of local government. Slope approach roads and stairs onto the right of the way for maintenance staff are located every 5 km and 1.5 km respectively along the railway line.

2.3.1.4 Taiwan High Speed Rail (THSR)

- Right-of-way system-length is fenced.
- 2.0 meter high fences are constructed on both sides of embankment and open-cut segments of the alignment, and around tunnel portals and any other location where needed to prevent access by persons and large animals onto the tracks.
- Fencing is placed around all building sites for signals and controls and for traction power supply facilities.
- Wide gates providing access for emergency vehicles are furnished at emergency egress locations. Single or double gates are provided where required for maintenance access. For each individual stretch of fencing, at least one gate is provided on each side of the tracks. Gates are equipped with locks that require a key for opening from the outside, but no key is required from the inside.
- Fences and gates are required to be bonded to the main system earth and a continuity strap is carried below all gates to avoid the hazard of electric shock due to touch potential.
- Wherever possible, high-speed train tracks were built over top of the roadway to minimize the risk of a motor vehicle intruding into the high-speed train right-of-way.

2.3.2 Access Control in the United States

The following subsections contain excerpts of design criteria from passenger rail providers (Caltrain and Metrolink) and rapid transit systems (MARTA and BART) in the United States.

2.3.2.1 Caltrain

a. Right-of-Way Access Considerations

All right-of-way access locations shall be controlled to prevent trespassing and vandalism. Permanent right-of-way access shall contain sufficient controlled access space to the right-of-way for maintenance personnel and construction contractors, maintenance vehicles and emergency vehicles. Typical maintenance or emergency vehicles are one ton trucks.

Station layout shall include provisions for roadway maintenance trucks to access the tracks on both sides of the station. If access is to be provided from the public parking or driveway areas, a locked gate shall be installed to keep unauthorized vehicles from entering the right-of-way.

b. Center Fence

Where two (2) or more tracks serve a station, a center fence shall be provided for the full length of the platforms and at least 100 feet beyond the end of platform or beyond the pedestrian crossings. The fence shall be six (6) feet in height from top of rail to act as a deterrent to climbing and prevent from passing through the fence, as well as indirectly guide passengers to the pedestrian crossings. The fence is designed to be sturdy to withstand vandalism and to allow for hanging of various station signage. Centerline of fence shall be 8 feet 6 inches (8'-6") minimum clear from centerline of tracks.

c. Right-of-Way Fencing

Within the vicinity of a station the right-of-way fencing shall be installed to prevent any unsafe shortcut to the platform and to guide the passengers to the designated platform entrances. The fencing shall be a minimum of six (6) feet high.

Fencing shall be installed along the entire length of all parking areas adjacent to Caltrain right-of-way. Fences adjacent to roadways and parking lots should be set back and protected by curbing to allow for vehicular overhangs. The fencing outside of the station area shall generally be eight (8) feet high right-of-way fencing. Right-of-way fencing includes access gates for maintenance personnel.

2.3.2.2 SCRRA / Metrolink

a. Right-of-Way Fencing

Access to the SCRRA tracks should be controlled by fencing or other barriers, typically a welded wire mesh 6 feet high. Fencing shall be parallel to the track, forming an open-ended envelope and allowing unrestricted movement by SCRRA crews. Fence height shall be reduced to 4 feet at a distance of 150 feet either side of road crossings. Vehicle service, maintenance, and storage areas shall be secured by perimeter fencing. Size and type of fencing or barrier shall be as determined by site-specific requirements. All construction site and work areas shall be secured by temporary fences or barricades.

b. Right-of-Way Fencing at Passenger Stations

Where railroad right-of-way within the vicinity of a station would allow passengers to trespass onto the right-of-way as a short cut to the platform the station designer shall provide right of way fencing to direct the passengers to the designated platform entrances. The fencing shall be welded wire and at least six feet high. Right of way fencing shall include access gates for right of way and track maintenance.

c. Removable Inter-Track Fence

Where two (2) or more tracks serve a station, a removable inter-track fence shall be provided for the full length of the platforms and at least 150 feet beyond each end. The fence shall be 6'-0" in

height, to discourage climbing and prevent people from passing through the fence. A fence height of 4'-0" is suggested within 150 feet of an at-grade pedestrian crossing. A fabricated steel fence is Metrolink's suggested method of construction. Track spacing in the vicinity of the inter-track fence shall be a minimum of 18 feet.

2.3.2.3 MARTA

The following subsections are excerpts from the design criteria manual for Metropolitan Atlanta Rapid Transit system.

a. Fencing

MARTA right-of-way shall be protected by fencing during both construction and operation, where required, to prevent entry by unauthorized persons or animals. Facilities within the right-of-way requiring a high degree of security shall be enclosed. Types of fencing to be used are:

- Construction Fencing
- Maximum-Security Permanent Fencing
- Minimum-Security-Permanent Fencing

Construction Fencing: During construction, and until permanent fencing is installed, MARTA property shall be protected by temporary fencing. Temporary locations shall be indicated for each construction stage if required by construction sequencing.

Maximum-Security Permanent Fencing: After construction of the trackway, the MARTA property shall be protected by permanent chain link fencing. Maximum-security permanent fencing shall be installed at locations requiring a high degree of security.

Maximum-security fencing shall be seven feet high consisting of six feet of fabric topped by three strands of barbed wire. The barbed wire shall be fastened to extension arms inclined away from the MARTA property. If clearances do not permit inclining the arms toward the MARTA property, they shall be vertical. Extension arms shall have adequate strength to support a 150-pound load normal to the arm at its outer end. Extension arms shall be of the same finish as the posts.

Landscaping shall be carefully controlled to assure that no large trees or plants provide an easy method of access over the fence.

Minimum-Security Permanent Fencing: Minimum-security fencing shall be used at locations not requiring a high degree of security. Minimum-security fencing shall be six feet high consisting of six feet of fabric and no barbed wire.

Grounding of Fencing: All permanent fencing shall be grounded by wire connecting the fencing to a grounding rod. The wire shall be galvanized steel not smaller than 2/0 AWG and shall be exothermically welded to fencing and grounding rod.

After installation, the resistance of each grounding shall be measured and recorded. A resistance of two ohms is desirable, but in no case shall the resistance exceed five ohms. The measurement shall not be made within 48 hours of rainfall or watering.

b. Location of Permanent Fencing

At-Grade Sections: Maximum-security fencing shall be provided continuously along each side of all at-grade sections. Security of at-grade fencing begins with attention to earthwork, grading, and drainage. The fence specifications require that the bottom of the fabric be within two inches of grade. The grading specifications require that the earthwork in the line of the fence be properly performed to hold the surface under the fence to this two-inch tolerance and to assure that the earth is well compacted so that it will not settle after the fence is constructed.

Fence should not be located on cut slopes or trackway embankments except where absolutely required by right-of-way and earthwork restrictions. Where the fence is near or parallel to the shoulder point of a slope, the earth shall be thoroughly compacted and, if necessary, the shoulder point shall be hard-surfaced with asphalt concrete or equivalent for a distance of three feet on

each side of the fence, or a continuous concrete curb shall be installed under the fabric to prevent erosion of the earth under the fence.

Retained Sections: Where the wall of a depressed section of MARTA trackway lies essentially on the right-of-way line, maximum-security fencing shall be installed on top of the retaining wall.

Where a retaining wall adjacent to the MARTA trackway extends above the adjacent ground level, and the wall lies essentially on the right-of-way line, maximum-security fencing shall be installed on top of the wall. In such cases the combined height of the wall and the fence above the adjacent ground line shall be not less than seven feet, and a chamfer shall be specified.

Fencing between at-grade and retained sections shall be continuous.

Subway Sections:

- Where at-grade sections adjoin subway sections, the right-of-way maximum-security fencing shall extend beyond the portal by a minimum of 30 feet where possible and be continuous across the right-of-way at that point. Where the minimum of 30 feet cannot be achieved because of physical constraints or an adjacent public way, the fencing shall extend across the right-of-way at the point of constraint.
- MARTA property above subway sections shall be fenced with minimum-security fencing only where necessary to prevent undesirable use of the property.

Aerial Structures: MARTA right-of-way under aerial structures shall be fenced where necessary to prevent trespassers from climbing up onto the track, to deter vehicles from striking the underside of the structure, and to prevent undesirable use of the property such as dumping trash or parking vehicles.

At abutments of aerial structures, maximum-security fencing from adjoining sections shall be continued beyond the abutment to a point where the underside of the structure is 10 feet or more above the natural ground line. At that point the two-right-of-way fences shall be joined under the aerial structure.

Any area under an aerial structure where the ground level is less than 10 feet below the underside of the structure shall be enclosed with maximum-security fencing.

No fencing is required under an aerial structure where the right-of-way adjoins property which is already fenced in a manner consistent with these criteria.

Enclosed Areas within MARTA Right-of-Way: High voltage electrical installations, other than contact rails, within MARTA right-of-way shall be enclosed with maximum-security fencing, unless adequately protected by walls.

Fence Distance from Right-of-Way: Generally, it is not desirable to locate the maximum-security fencing adjacent to the MARTA right-of-way line because of restrictions placed on maintenance operations within the secured right-of-way. Where applicable, the fencing shall be located at a minimum distance of 10 feet from the toe of slope when the MARTA section is in cut and 10 feet from the top of slope when the section is on embankment. In any case, the fence shall be placed no closer than one foot from the MARTA right-of-way line unless approved by MARTA.

Fence Distance from Track Centerline: No part of the fencing on at-grade sections shall be nearer than 11'-6" to the centerline of the adjacent track. No part of the fencing on retaining walls shall be nearer to the track than the face of the wall unless the fence is above the height of the dynamic car excursion envelope.

Traffic Barriers and Barricades: Where there is a possibility of vehicles accidentally entering onto the MARTA trackway or into construction or maintenance sites, warning devices and/or physical deterrents shall be provided.

- Traffic barriers are used to physically prevent entry of vehicles into the protected area.
- Traffic barricades are used to warn approaching drivers of hazards created by construction or maintenance activities on or near the travelled way and to direct drivers safely by the hazards.

- Rigid traffic barriers may be extended in height for acoustical purposes upon determination of the structural capability of the barrier.

Traffic Barriers Types: Barriers shall be either rigid or semi-flexible depending on the degree of hazard involved.

- Rigid barriers shall be concrete barriers.
- Semi-flexible barriers shall consist of blocked-out, continuous corrugated steel rails supported by steel posts spaced six feet three inches on centers. The top of the rail shall be two feet three inches above the roadway surface at the barrier.

Barricades Types: Traffic barricades shall be used to warn motorists of hazards on or near the roadway adjoining the MARTA trackway and on MARTA streets. They shall not be used where safety considerations dictate the need for a traffic barrier to physically prevent vehicles from intruding into the protected area. Barricades shall be one of two types depending on the degree of permanence required.

- Barricades Type A shall be constructed so as to be self supporting and portable.
- Barricades Type B are not portable and require embedded anchor posts.

Fencing Distance from Traffic Barriers: Maximum-security fences shall be preferably three feet or more from the back side of a semi-flexible traffic barrier and shall be seven feet high. Where maximum-security fences are closer than three feet to a barrier, the fabric height shall be increased by an amount equal to the height of the traffic barrier for a distance not less than ten feet past each end of the barrier, or when the barrier is curved, not less than ten feet past the point where the fence is three feet from the barrier. Where fencing is on a rigid barrier the combined height of fence and barrier shall be not less than 7'-0".

Required Locations for Traffic Barriers:

- Barriers are not required where the difference between finished grades provides an effective deterrent to vehicle encroachment.
- Between MARTA System Tracks and Roadways: A continuous traffic barrier shall be installed where MARTA System tracks adjoin freeway traffic lanes, and where the tracks are in such proximity to the traveled way of other adjoining roadways as to cause a hazard. In this case, special attention shall be given to the possible occurrence of vehicular trajectories passing over the barrier at the outside of a curve where the pavement slopes up toward the barrier and the side slope of the roadway embankment is inclined down toward the barrier.
- At curves on MARTA System Streets: A traffic barrier shall be installed on MARTA System streets at the outside of any curve where safety considerations dictate a speed less than the posted maximum street speed.
- At Dead-End Streets: A traffic barrier shall be installed at the end of dead-end streets and "T" intersections that are so close to the tracks as to cause a hazard. The barrier length shall be sufficient to intercept all vehicular paths from within the traveled way of the approaching street.
- Roadways Paralleling MARTA System Tracks: Where the distance from the centerline of nearest track to roadway face of barrier is less than 17 feet, a 48" high concrete traffic barrier shall be used. Where the trackway and an adjoining roadway are separated by a retaining wall, the wall shall be extended four feet above the roadway to serve as the barrier, and the wall face next to the roadway shall be shaped to conform to the aforesaid concrete barrier.

A semi-flexible type traffic barrier shall be used where the distance from the centerline of nearest track to roadway face of barrier is 17 feet or more.

- Dead-end Streets at MARTA System Tracks: A semi-flexible type traffic barrier shall be used where streets having relatively flat grades dead-end at MARTA system tracks.

A concrete traffic barrier, consisting of a minimum 18-inch thick reinforced concrete wall, shall be provided where steep grades and proximity of the track require a substantial physical barrier against runaway vehicles. The top of the barrier shall be five feet above the street surface at the barrier.

- **MARTA System Roads:** Traffic barriers shall be provided at roadway curves and other locations where the traffic barrier is not required to prevent vehicular entry upon the trackway. The barrier shall be the semi-flexible type as specified hereinabove.

c. Gates

Gates shall be provided so that all fenced areas are accessible from outside the fenced area. Normally, gates shall be walk gates, four feet in width. Where vehicular access is required, drive gates at least 10 feet in width shall be provided. Provision shall be made for all gates to swing not less than 90 degrees into the MARTA right-of-way, and preferably gate swing shall be 180 degrees into the MARTA right-of-way. The swing of the gate shall be such that no part can be closer than 8'-6" to the centerline of a MARTA track.

Construction Fencing Walk Gate: Where required for access to the site by authorized personnel, a walk gate shall be installed. Such gate shall be six feet high and four feet wide, mounted on four-inch by four-inch wood posts, and provided with a galvanized steel chain and padlock.

Construction Fencing Drive Gate: Where required for authorized vehicular access to the work site, a drive gate shall be installed.

Maximum Security Gates: Gates in maximum-security permanent fencing shall have extension arms to match those of the adjacent fencing. Gate hinges shall be arranged to prevent the removal of the gate from the hinges without mechanical disassembly of the hinges. In addition to the latching mechanism which holds the gate in alignment when closed, the gate shall be provided with a galvanized steel chain and padlock. Locking of the vertically operated latching mechanism does not provide sufficient security.

It should be noted that if the earthwork is held to a line that is two inches below the bottom tension wire, the opening under the gate will be four to six inches high. To preclude such a high opening, the paving under the gate shall be raised to an elevation within two inches of the bottom of the gate. The ground surface under drive gates shall be paved with two inches of asphalt concrete on eight to twelve inches of compacted granular fill for a distance of three feet on each side of the centerline of the fence to assure that heavy equipment traveling through the gate opening will not depress the earth and permit passage under the gate.

Location of Gates: Gates in permanent fencing are for the purpose of permitting ingress to and egress from the MARTA right-of-way by maintenance workers, and access for fire fighting and emergency personnel and equipment.

Where these access points are more than one-half mile apart, additional drive gates shall be provided at one-half mile intervals where frontage roads make it practicable for emergency vehicles to get to the MARTA trackway. Walk gates shall be provided between drive gates so that the interval between gates will be no greater than one-quarter of a mile.

2.3.2.4 BART

a. General

The San Francisco Bay Area Rapid Transit (BART) system consists of over 100 miles of trackway with 43 stations throughout Northern California. BART's electrification system is powered by 1000 volts of direct current, supplied to revenue vehicles through contact rail system mounted outside of and in parallel with the running rails. BART trackway is a combination of at-grade, aerial and subway construction segments. Continuous walkway adjacent to all BART tracks are provided for emergency evacuation and maintenance access

b. Fencing

Fencing of at-grade right-of-way is the principal means of protecting BART passengers as well as pedestrians and vehicles outside the BART right-of-way from the hazards of moving trains and

the electric third rail. Security provided by the fence for at-grade sections is subject to the approval of the CPUC and to its authority to make changes and additions if, in its opinion, fencing is not adequate. Right-of-way fencing conforms to the requirements of CPUC General Order No. 95, Rule 79.4, except as amended below.

Maximum Security Fencing: Fencing used to deny access to BART trackways and fencing used to maintain security of BART System property which requires a high degree of security, shall be 8 feet high consisting of 7 feet of chain link fabric topped by three strands of barbed wire, 12 inches high, or combinations of walls or barriers with chain link fabric and barbed wire with a total height of 8 feet. Chain link fabric shall be attached to posts, tension wires and rails on the side facing away from BART property. The fence shall have barbed wire extension arms inclined away from the BART property. Where it is absolutely impossible to incline the extension arms away from the BART property, they shall be installed vertically. Extension arms, in addition to carrying the barbed wire, shall have adequate strength to support a 300-pound vertical load applied at their outer end.

Minimum-Security Fencing: This type of fencing is used to maintain security of BART System property that does not require a maximum degree of security. Minimum-security fences 6 feet high, consisting of 6 feet of fabric, and no barbed wire. All other fencing requirements described herein also applies to minimum-security fencing.

Grounding of Fencing: All permanent fencing used by BART is grounded.

Depression under the Fence: The security provided by at-grade fencing begins with attention to earthwork, grading, and drainage. Depressions of more than one inch under the fence shall be prevented. The bottom tension wire shall be within 1 inch of grade. Earthwork in the line of the fence shall be properly performed to hold the surface under the fence to this 1-inch tolerance and to assure that the earth is well compacted so that it will not settle after the fence is constructed. Fence shall not be located on slopes of cut banks or trackway embankments except where absolutely required by right-of-way and earthwork restrictions. Where the fence is near or parallel to the top or bottom of a slope, the earth shall be thoroughly compacted and, if necessary to prevent erosion of earth under fence, the shoulder shall be hard-surfaced with asphalt concrete or equivalent for a distance of 3 feet on each side of the fence.

Fencing for Protection against Vandalism: BART facilities requiring an increased level of security, due to extreme danger to the public or areas susceptible to vandalism, shall be protected as described above with the addition of razor ribbon coil wire or barbed tape spiral affixed to the top of the fence. Razor wire coils shall be securely fastened to the tension wire or top rail and to the barbed wire strands and shall be secured so that they are not suspended lower than 7'-0" above ground. The facilities requiring this additional security shall be as designated by the District on a case-by-case basis.

Fencing Along at-Grade Sections: Maximum-security fencing as described above shall be provided continuously along each side of all at-grade sections, including transitions to subway or aerial sections.

Fencing on Retaining Walls and Traffic Barriers: The following requirements are prescribed for the various trackway scenarios:

- a) Where a wall of a retained fill or open cut section or a concrete traffic barrier adjacent to a BART trackway lies essentially on the right-of-way line, maximum security fencing shall be installed on top of the retaining wall or traffic barrier.
- b) Where a retaining wall adjacent to the BART trackway extends above the adjacent ground level, and the wall is located essentially on the right-of-way line, maximum-security fencing shall be installed on top of the wall or traffic barrier. In such cases, the combined height of the wall or traffic barrier and the fence above the adjacent ground outside the BART right-of-way shall be not less than 8 feet, including wall, chain link fabric and 1 foot of barbed wire, in accordance with the respective Civil Standard Drawings.
- c) Where a retaining wall is well within the right-of-way line, security fencing shall be located in accordance with other requirements and shall not be placed on top of the wall.

- d) Fencing between at-grade and retained sections shall be continuous.
- e) Where a retaining wall is used as support for both fencing and light poles or signs, the open space between the fence and the light pole shall be less than six inches.

Fencing Along Aerial Sections:

- a) Where right-of-way for aerial structures abuts private property that is not fenced, maximum-security fencing shall be installed.
- b) Where right-of-way abuts industrial property and the industrial property has a fence equivalent to 6 feet high chain-link fence, it will not be necessary to install another fence.
- c) At abutments of aerial structures, maximum-security fencing from adjoining sections shall be continued beyond the abutment to a point where the underside of the structure is 10 feet or more above the natural ground line. At that point, the right-of-way fences on each side of the aerial structure shall be joined under the aerial structure.
- d) All aerial structure sections, where the ground level is less than 10 feet below the underside of the structure, shall be enclosed with maximum-security fencing.
- e) No fencing is required under an aerial structure where the right-of-way adjoins property which is already fenced in a manner consistent with these criteria.
- f) Where right-of-way for aerial structure abuts public property, fencing will not be required except as noted above at abutments.

Fencing Adjoining Subway Sections:

- a) Where at-grade sections adjoin subway sections, the right-of-way maximum-security fencing shall extend beyond the portal by a minimum of 30 feet where possible and be continuous across the right-of-way at that point.
- b) Where the minimum of 30 feet cannot be achieved because of physical constraints or an adjacent public way, the fencing shall extend across the right-of-way at the point of constraint.
- c) BART property above subway sections shall be fenced with minimum-security fencing to prevent undesirable use of the property unless otherwise required by the District.

Fencing along Playgrounds and Schoolyards: Where right-of-way abuts either playgrounds or schoolyards, the surface under the fence shall be paved to inhibit any undermining of the chain link fabric.

Location of Right-of-Way Fencing

- a) The fence shall be placed inside BART property 12 inches from the right-of-way line with the barbed wire extension arms inclined away from the BART property. Where the extension arms are vertical, the fence shall be placed 4-1/2 inches from the right-of-way line.
- b) Where fencing is located on or adjacent to streets or traffic barriers, the minimum distance between fence and track centerlines shall be the clearance line for installations.
- c) Where right-of-way of at-grade sections adjoin public property, fencing may be located further from the right-of-way line than indicated in paragraph a) above provided that the following conditions are met:
 - A public authority requests that the fence be moved closer to the adjacent track and agrees to police and maintain the area between the fence and the right-of-way line.
 - A minimum distance of 13 feet is maintained between the post centerlines and the adjacent BART track centerline.
 - The fencing is installed as close to the track as practical (not on slope of trackway embankment), and only the area outside of the fence is landscaped.

- d) Location of fencing, walls and right-of-way lines between BART and other trackways shall be as jointly agreed between BART and jurisdictional authority.

Fencing of High Voltage and Other Facilities: Maximum-security fencing shall be provided to deny access to high voltage installations, such as substations, gap breaker stations, areas containing BART System property adjoining private and public property, and other areas where so required.

Fencing or enclosures for such areas shall be 9 feet high, consisting of 8 feet of chain link fabric, secured at the top and bottom to galvanized pipe rail, topped by three strands of barbed wire, 12 inches high, unless these facilities are adequately protected by a minimum of 9-feet-high walls. All other requirements described above also apply to fencing of high voltage and other facilities.

Fencing at Drainage Facilities: Where drainage requires passage under the fence, open ditch crossings shall be avoided and culverts preferably shall be provided.

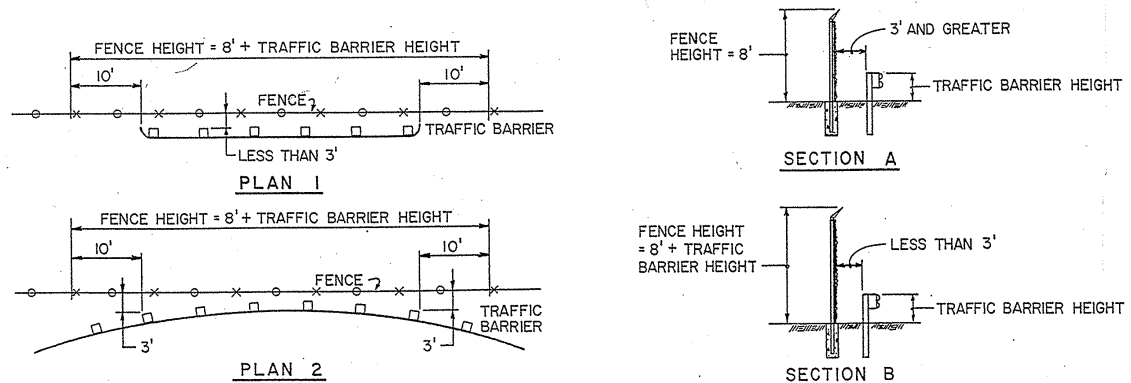


Figure 2-1
Fence Height Requirements Adjacent to Track Barriers

Fencing Adjacent to Traffic Barriers: Maximum security fences shall preferably be placed 3 feet away from the backside of the adjacent rigid or a semi-flexible traffic barrier and shall be 8 feet high. Where maximum security fences are closer than 3 feet to the barrier, the fabric height shall be increased by an amount equal to the height of the traffic barrier for a distance not less than 10 feet beyond each end of the barrier, or when the barrier is curved, not less than 10 feet beyond the point where the fence is 3 feet from the barrier. (See Figure 2-1.) Where fence is on a rigid barrier, the combined height of the fence and barrier shall be not less than 8 feet.

Safety Railing on Top of Retaining Walls: Safety pipe railing, consisting of 1-1/2-inch diameter welded galvanized steel pipe, is installed along the top of retaining walls where access to the top of wall is not restricted. The top of railing shall be 3 feet above the walking surface next to the top of wall. Safety railing shall not be used where maximum security fencing along the top of the wall is required by these criteria.

c. Gates

Gates of 4 feet minimum width are provided for personnel/equipment access to all fenced areas, regardless of the size. Where vehicular access is required, driving gates with 12-foot minimum width are provided. The appearance of all gates shall be established in coordination with the adjacent chain link fence configurations in fabric, barbed wire, and extension arms.

Gates Location:

- a) Gates along the BART system are located at approximately one-half mile intervals. Gates are provided on both sides of the right-of-way at the same milepost. Spacing of gates is such that the unobstructed distance from any point within the fenced area to the nearest gate does not exceed approximately one quarter of a mile. In accordance with this requirement and where fencing is required along at-grade and aerial sections, gates are provided at approximately one-half-mile intervals on each right-of-way side of the tracks along at-grade

- sections, and at approximately one-half-mile intervals on either, but not on both, sides of the trackway along aerial sections.
- b) Driving gates are used along right-of-way wherever practical.
 - c) Walking gates are provided between driving gates so that the distance between gates does not exceed one-quarter of a mile.
 - d) Gates are located as close as possible to adjacent streets or roads for easy access of emergency vehicles.
 - e) Gate locations along fencing in freeway medians require Caltrans approval.
 - f) Requirements for gates along fencing and on top of traffic barriers require approval by the local fire protection agency.
 - g) At gates located in walls or concrete traffic barriers where the concrete section of fencing exceeds a height of 3'-0" above grade on the BART right-of-way side of the fence, the grade level is elevated or a step is provided such that the step down distance does not exceed 3'-0".
 - h) Personnel/equipment gates are coordinated with the local fire service agency. For emergency access designated gates, information that clearly identifies the route and location of each gate are provided on the gates or adjacent thereto per NFPA 130.

Maximum-Security Gates: Gates in maximum-security fences have their extension arms inclined to match the extension arms on the adjacent fence except when inclined extension arms will interfere with gate operation; in those cases the extension arms are vertical.

Gate hinges are arranged to prevent the removal of the gate from the hinges without mechanical disassembly of the hinge. Single swing gates have a padlockable fork latch and pairs of swing gates have a padlockable drop post. Pairs of swing gates have drop rods which hold the gate in alignment when closed.

The ground surface under drive gates is paved with 2 inches of asphalt concrete on 8 inches of compacted granular base material for a distance of 3 feet on each side of the centerline of the fence to assure that heavy equipment travelling through the gate opening will not depress the earth and permit passage under the gate. Clearance between the bottom of the gate and top of the pavement is kept to 2 inches.

d. Signs

Fences and gates along right-of-way lines are marked with proper signs. Specific guidelines for the development of such signs are covered under separate document.

e. Landscaping

Landscaping shall be carefully controlled at security fencing to assure that no large trees or shrubs provide an easy method of access over the fence. Fencing and trees shall be kept apart a minimum of 5 feet. Future growth of the landscaped materials shall be considered.

3.0 ASSESSMENT / ANALYSIS

The recommendations for access control to be used for the CHSTP are based on an assessment of relevant federal and state laws, current practice used by other operating HST systems and proven performance of the access control system used by transit service providers in the United States. In particular, the guidelines of transit service providers operating on electrified rail in the state of California were considered to be applicable because these achieve the regulatory requirements of local agencies including the California Public Utilities Commission (CPUC).

In addition the following key considerations have been identified as the basis for establishing emergency and maintenance access requirements to the HST corridor¹:

- Vehicular access shall be provided at regular intervals.
- Access locations shall be facility driven, i.e., coordinated with the location of wayside facilities requiring access such as interlockings, tunnel portals, tunnel shafts, signal housing, etc.
- Vehicular access shall be provided at stations, traction power substations, maintenance of way facilities, and rolling stock maintenance facilities.
- There shall be no routine maintenance performed within the HST right-of-way during revenue service hours.
- Passenger evacuation from high-speed trains or stations into the HST right-of-way is a last option for emergency response. The assumption is that trains will proceed to the next station or that a rescue train will be used to either push the disabled train or to provide for train to train transfer of passengers.
- Continuous access road adjacent to the HST right-of-way is not required to support emergency response or operational and maintenance activities.
- In general, access control under aerial HST structures is not required.

3.1 GENERAL

Unauthorized access to HST facilities and equipment shall be prevented in order to avoid injury to persons and animals, theft, damage of HST equipment, vandalism to HST property or disruption of high-speed train operation.

The following sections establish criteria for the type of infrastructure elements such as fences, walls, traffic barriers, gates and signs recommended for controlling access to HST properties and their applications per type of trackway, facilities and location.

3.2 ACCESS CONTROL INFRASTRUCTURE

The entire HST right-of-way shall be protected with a fence, wall or fence-wall, fence-traffic barrier or wall-traffic barrier in combination to avoid unauthorized access by people, vehicles or animals.

3.2.1 Fences

Protection of HST property by means of fencing shall be done during construction phase by temporary fencing and thereafter by permanent fencing. This document addresses the use and type of permanent fencing.

Permanent fencing to be used in HST property is as follows:

- Access Restriction (AR) Fencing
- Access Deterring (AD) Fencing

¹ EMT Integration meeting August 10, 2010

3.2.1.1 Access Restriction (AR) Fencing

AR fencing is permanent fencing used to deny access to the HST trackway and to protect HST system property which requires a high degree of security. AR fencing is also used on areas where the risk of trespassing is high and the consequences may result in injury to trespassers and impact on HST operation.

AR fences shall meet the following minimum material and height requirements. Alternative fencing material may be used as long as it meets or exceeds these minimum requirements and upon approval from the Authority or its representative.

Fencing shall extend from ground level to a minimum height of eight (8) feet, consisting of minimum seven (7) feet of galvanized steel woven mesh or links (commonly known as chain link or cyclone fencing) secured at the top and bottom to galvanized pipe railing, topped by three strands of barbed wire, twelve (12) inches high.

The barbed wire extension arm shall be placed inclined at a 45 degree angle away from HST property. In areas where, due to right-of-way, clearance or other restriction, if the barbed wire arm cannot be placed at a 45 degree angle, it can be placed vertical.

Fence posts shall be cast into concrete footings (Figure 3-1), set into concrete retaining walls or set in rigid traffic barriers. Where a change in direction in the line of fence is five degrees or more, corner posts shall be installed and braced as shown in Figure 3-2.

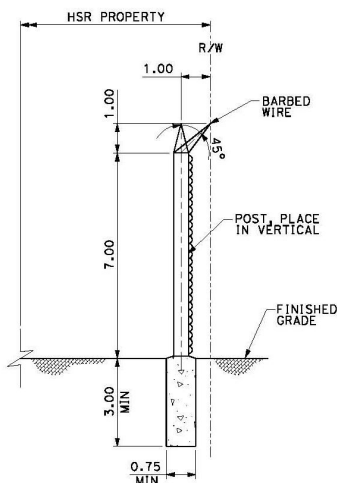


Figure 3-1 – Fence Post

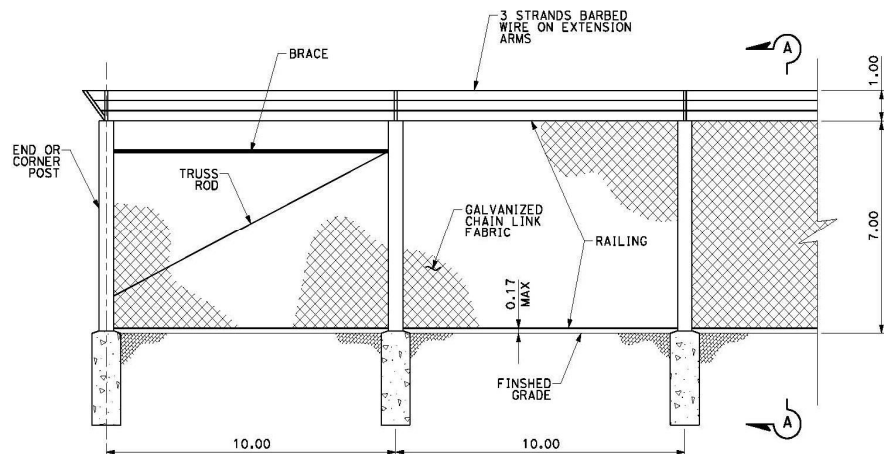


Figure 3-2 – Access Restriction (AR) Fence

AR fences shall be located inside HST right-of-way within a distance of one foot from the right-of-way line with the barbed wire extension arms inclined away from the HST property (Figure 3-1).

Combinations of walls or barriers with chain link fabric and barbed wire with a total height of eight (8) feet measured from the highest ground surface adjacent to the fence or barrier can also be used as AR fencing.

3.2.1.2 Access Detering (AD) Fencing

AD fencing is permanent fencing used to deter access and/or prevent from passing through to areas that do not require a high degree of security. AD fences can also be used in areas where the risk of trespassing is low, such as along viaducts or where trespassing will not result in injuries to trespassers or cause operational impact. AD fencing shall be six (6) feet high, consisting of six (6) feet of chain link fabric, secured at the top and bottom to galvanized pipe railing and no barbed wire. Fence posts shall be cast into concrete footings, set into concrete retaining walls or set in rigid traffic barriers.

3.2.1.3 Grounding of Fencing

Permanent fencing shall be bonded and grounded to prevent electric shock from induced voltage. Refer to TM 3.2.6 for additional details on the requirements for grounding of fences.

3.2.2 Walls

Walls may be used to prevent intrusion by vehicles into HST property. When appropriate, walls may be used in combination with fences at the following locations:

- Where there is vertical separation
- Where there is close proximity between the HST trackway and an adjacent transportation facility
- Between main tracks and station tracks to protect passengers and patrons at station platforms from the effects of noise and aerodynamic forces caused by passing trains.

3.2.3 Traffic Barriers

Traffic barriers may be required where the HST right-of-way abuts public and private roads and highways and at highway overpasses where there is a potential of vehicles accidentally entering the HST right-of-way. Traffic barriers used to protect HST trackway shall be Caltrans Standard traffic barrier of the following types:

- a. **Rigid Traffic Barrier.** Shall be used where HST trackway is in close proximity to freeway traffic lanes and/or the travelled way of any adjoining roadway. Rigid traffic barriers shall be Caltrans Concrete Barrier of three (3) to five (5) feet height as required for the roadway traffic conditions (i.e., speed, number of trucks, etc) and location (i.e., on steep slope, along small radii curves etc.). Rigid traffic barriers shall be used in conjunction with AR fences to prevent intrusion into HST trackway from adjacent roadways. Design and construction details for Caltrans Concrete Barriers of the various types can be found in Caltrans Standard Plans.
- b. **Semi-flexible Traffic Barrier.** Shall be used along service and maintenance roads located within HST right-of-way except when such roads are located in close proximity to any track in which the placement of barriers may compromise the trackway clearance envelope. Semi-flexible barriers shall be placed at the outside of curve as required by safety considerations, to delineate the roadway and maintain vehicles within the roadbed. Semi-flexible traffic barriers shall be Caltrans Metal Beam Guard Railing of the appropriate type for the local condition. Design and installation details for Metal Beam Guard Railing can be found in Caltrans Standard Plans.

3.2.4 Fencing and Traffic Barriers in Combination

AR fencing shall be located preferably three feet or more from the back side of a semi-flexible traffic barrier. Where three feet separation cannot be achieved, rigid traffic barriers shall be used and fence height shall be increased by a height equal to the height of the barrier. Where AR or AD fencing is installed on top of a rigid barrier the combined height of fence and barrier shall be not less than 7'-0".

3.2.5 Gates

- a) Gates with locking devices shall be provided along fenced areas to allow access to authorized personnel, emergency vehicles, and maintenance equipment.
- b) Gates shall be constructed of the same material and height as adjacent fence and shall not decrease the level of security provided by the fences.
- c) Gates for personnel and equipment access (walking gates) shall have a minimum width of four (4) feet.

- d) Gates for vehicular access (driving gates) shall be sized in coordination with emergency responders and maintenance equipment. If no other information is available these gates should have a minimum width of twelve (12) feet.
- e) Gates along right-of-way fencing may require approval by the local fire protection agency.
- f) Gates may be either swinging or sliding type. Driving swing gates shall be a pair and shall be hinged from the inside. Provision shall be made for swinging gates to swing not less than 90 degrees away from HST facilities.
- g) Driving gates shall be provided in conjunction with either access roads or at locations where existing roads make it practicable for emergency vehicles to get to the trackway.
- h) Gate locations along fencing within freeway right-of-way will require Caltrans approval.
- i) Gate locations shall be coordinated the location of HST wayside facilities requiring access from outside HST right-of-way.
- j) Along at-grade trackway, driving gates shall be located at approximately five² mile intervals on either right-of-way side. When possible, access gates should be staggered.
- k) At aerial sections, access to the trackway shall be made from stations or by mobile ladder equipment from roadways adjacent to the trackway. If no adjacent or crossing roadways exist, construction of access roads is required. Walking gates shall be provided along aerial structures at intervals of five (5) miles on either side of the trackway (not on both).

3.2.6 Signage

Fencing shall be provided with signs warning of hazards from HST operations, high voltage electrical installations, and any other relevant hazards, at any location where the public may reasonably be expected to approach the right-of-way.

Signs bearing the words "Danger", "High Voltage Lines" and "Keep Away" in letters at least three (3) inches in height, shall be installed at intervals of not more than 500 feet along each fence enclosing the rights-of-way, at every gate and at each station or passenger loading platform. The signs may carry other information relative to the hazard present, but the three required phrases (Danger, High Voltage Lines and Keep Away) shall be in type of larger size than the type of the additional items.

Signs bearing the message "No Trespassing" in letters of at least three (3) inches in height, and including the California Penal Code section number for trespassing in smaller letter size, shall be installed at a minimum, every 500 feet, at a height between five (5) and six (6) feet from the finished ground outside CHST property.

Additional guidance on signage will be developed to ensure consistency throughout the HST system.

3.2.7 Vegetation Control

Vegetation along fenced areas of HST property shall be controlled to ensure that trees or shrubs do not provide access over the fence by people or animals. Fencing and trees shall be kept apart a minimum of five (5) feet. Tree branches shall be kept five (5) feet away from any electrical lines that supply power to the HST system to prevent small animals from accessing the electric lines. Future growth of vegetation shall be considered when planning new landscaped areas.

3.3 ACCESS CONTROL BY TYPE OF HST TRACKWAY

Access to non-public HST property shall be controlled by installing perimeter fences along the right-of-way with locked gates to allow access and egress of maintenance and emergency personnel. Within the vicinity of passenger of a station, the right-of-way fencing shall be installed to prevent unsafe shortcut to the platform and to guide the passengers to the designated platform entrances.

² Per EMT Integration meeting notes of August 10, 2010

Access into the area of operating infrastructure may be protected with fences equipped with intrusion detection devices to alert of unauthorized entry.

3.3.1 At-Grade Trackway

AR fencing as described above shall be provided continuously along each side of at-grade HST trackway sections, including transitions to underground or aerial sections. Fence construction shall be designed, installed and maintained in such manner as to deny access over, under or through the fencing to unauthorized persons. The HST system shall have no at-grade public road crossings or at-grade crossings of other rail systems.

AR fences shall be located at one (1) foot minimum distance within the HST right-of-way line.

3.3.2 At-Grade Trackway within Highway Corridor

A combination of AR fence and an appropriate rigid traffic barrier shall be constructed along the HST right-of-way when it is at-grade, runs parallel and is adjacent to a highway traffic lane, including locations where the trackway shares a common corridor in a highway median.

The AR fence shall be located inside HST right-of-way at a minimum distance of one (1) foot from the HST right-of-way line. The traffic barrier shall be located within the highway right-of-way, as close as possible to the highway edge of travel lane or at a minimum distance of three (3) feet from the AR fence. The traffic barrier shall have a minimum height of 4'-6" above the highway grade level.

3.3.3 At-Grade Trackway Adjacent to Conventional Rail Transportation Systems

Protection against accidental intrusion from adjacent transportation facilities shall be considered where a HST trackway is in close proximity to another mode of transportation.

The preferred form of intrusion protection is adequate lateral separation. Where adequate lateral separation cannot be achieved, consideration can be made for a berm, a ditch or a physical barrier that will effectively prevent intrusion by an out-of-control vehicle from an adjacent transportation right-of-way.. Design and location of physical intrusion protection barriers shall be made in conjunction with site-specific risk analysis.

Additional requirements for intrusion protection are identified in a separate Technical Memorandum.

3.3.4 At-Grade Trackway through High-Risk Trespassing Areas

Special consideration shall be given to areas determined to have a high-risk of trespass such as, but not limited to, HST trackway adjacent to parks, playgrounds, schoolyards, highly populated urban areas or areas within the pathway to and from any of these places, which require a higher degree of security. An eight (8) foot high, AR type fence fabricated of a stronger material which offers higher anti-climbing and cutting-detering levels may be required at these locations. In addition, the surface under the fence may be paved to prevent undermining.

3.3.5 Trackway in Cut or Fill (Embankment) Section

AR fencing shall be used for HST trackway along embankment and cut sections. AR fences shall not be placed on the slope surfaces of the cut or embankment sections.

When the HST trackway section is in cut, AR fences shall be located at a distance from the top of slope

- Desirable 10 feet
- Minimum 3 feet
- Exceptional 1 foot

When the HST trackway section is on embankment, AR fences shall be located at a distance from the toe of slope:

- Desirable 10 feet
- Minimum 3 feet
- Exceptional 1 foot

3.3.6 Trackway on Aerial Structure

- a) At abutments of aerial structures, AR fencing from adjoining sections shall be continued beyond the abutment to a point where the soffit of the structure is ten (10) feet or more above the ground line. At that point, the right-of-way fences on each side of the aerial structure shall be joined under the aerial structure.
- b) Where the ground level is less than ten (10) feet below the underside of the structure, aerial structure sections shall be protected with AR fencing located two (2) feet from the drip-line of the structure. Fencing is not required under an aerial structure where the right-of-way adjoins property which is already fenced in a manner consistent with these criteria.
- c) Where right-of-way for aerial structure abuts public property, fencing is not required except at abutments.
- d) Emergency access to the trackway shall be from stations or by mobile ladder equipment from roadways. If no adjacent or crossing roadways exist, access at maximum 5 mile³ intervals shall be provided.
- e) Access to the structure shall be maintained for inspection and maintenance. The superstructure shall remain accessible longitudinally for five (5) feet outside of the structure drip line for purposes of inspection and emergency access.
- f) Area around the columns and foundations should remain accessible for ten (10) feet (minimum) outside of the foundation limits.
- g) It generally is not required to control access under long viaduct structures.
- h) Security in specific areas shall be enhanced if found to be problematic or if anticipated to be an area of concern.

3.3.7 Trackway on Retained Fill

Retained fill trackways have at least one vertical wall exceeding five (5) feet in height measured from finished surface along the non trackway side of the wall.

- a) AR fencing shall be installed on top of retaining walls or rigid traffic barriers along retained fill sections on the following conditions:
 - When retaining walls are located at the right-of-way line along HST trackway and the adjacent land outside HST property is less than ten (10) feet below the top of the wall.
 - When the concrete barriers are located on the right-of-way line, adjacent to a HST trackway.
 - The combined height of the wall or traffic barrier and fence above the adjacent ground outside the HST right-of-way shall be not less than eight (8) feet, including wall, chain link fabric and one (1) foot of barbed wire.
- b) Where a retaining wall is well within the right-of-way line, security fencing shall be located in accordance with other requirements and shall not be placed on top of the wall. Railing may be required along the top of wall.
- c) Fencing between at-grade and retained fill sections shall be continuous.
- d) Where a retaining wall is used as support for both fencing and poles supporting lights, OCS or signs, the open space between the fence and the pole shall be less than four (4) inches.

³ Per EMT Integration meeting notes of August 10, 2010

- e) Emergency access to retained fill trackway shall be from stations or by mobile ladder equipment from nearby roadways. If no adjacent or nearby roadways exist, access roads shall be constructed in coordination with the locations of wayside facilities requiring access or at not more than five (5) mile intervals⁴.

3.3.8 Trackway on Retained Cut (Open)

Retained cut trackways have at least one vertical wall exceeding 5 feet in height measured from the top of rail.

- a) AR fencing shall be installed on top of retaining walls or rigid traffic barriers along retained cut sections on the following conditions:
 - When retaining walls are located at the right-of-way line along HST trackway and the adjacent land outside HST property is less than ten (10) feet above the top of the wall.
 - Concrete barriers located adjacent to a HST trackway on the right-of-way line.
 - The combined height of the wall or traffic barrier and the fence above the adjacent ground outside the HST right-of-way shall be not less than eight (8) feet, including wall, chain link fabric and one (1) foot of barbed wire.
- b) Where a retaining wall is well within the right-of-way line, security fencing shall be located in accordance with other requirements and shall not be placed on top of the wall. Railing may be required along the top of wall.
- c) Fencing between at-grade and retained sections shall be continuous.
- d) Where a retaining wall is used as support for both, fencing and poles supporting lights, OCS or signs, the open space between the fence and the pole shall be less than six (6) inches.

3.3.9 Trackway Underground (Bored, Mined and Cut and Covered Tunnels)

- a) Where at-grade sections adjoin underground sections, the right-of-way AR fencing shall extend beyond the portal by a minimum of 30 feet where possible and be continuous across the right-of-way at that point.
- b) Where the minimum of 30 feet cannot be achieved because of physical constraints or an adjacent public way, fencing shall extend across the right-of-way at the point of constraint.
- c) HST property above underground sections of HST trackway shall be protected in accordance with these criteria and the facility and/or use of the land above ground. If the use of the land above ground has not been defined and no facility has been constructed, perimeter AD fencing with gates is recommended to prevent undesirable use of the property.

3.4 ACCESS CONTROL BY TYPE OF FACILITY

This section prescribes right-of-way fencing requirements for wayside facilities, yards, maintenance facilities, signaling, and traction power facilities.

3.4.1 Yards and Maintenance Facilities

AR fencing with vehicular and pedestrian access gates equipped with locking devices shall be installed along the perimeter of HST yards and shops.

3.4.2 Overhead Catenary System, Signal and Traction Power Facilities

Signal housing, power supply substations, train control, communications equipment and switching and paralleling stations must be either fenced with AR fencing or a nine (9) foot high wall enclosure with secured gates.

⁴ Per EMT Integration meeting notes of August 10, 2010. Note that NFPA 130 requires that access roads be provided at maximum 2,500 foot intervals.

Where there is public access or trespass is likely, anti-climbing protection shall be provided at buildings and other structures supporting energized parts of the OCS. The anti-climbing protection should include signs warning of the dangers of high voltage. Access to fixed ladders, particularly at signal poles and signal gantries, and the means of access to any roof or other place, which could allow non-authorized persons to approach energized parts, shall be secured or otherwise protected.

3.4.3 Passenger Station

Perimeter AR fence shall be installed along the right-of-way within the vicinity of a station platform to prevent unsafe shortcuts to the platform and to guide passengers to the designated platform entrances.

3.4.3.1 Limits of Platforms

AD type fences with locked gates shall be installed at the ends of station platforms, along the sides of platforms perpendicular to the tracks, to prevent unauthorized access to the trackway.

3.4.3.2 Inter-Track Fencing

Inter-track fences shall be provided between through track and station track or between adjacent tracks at station platforms for the full length of the platforms and at least 150 feet beyond each end. Inter-track fence shall be AD type or better, 6'-0" height to discourage climbing and prevent people from passing through. Track spacing in the vicinity of the inter-track fence shall be:

- Desirable 18 feet
- Minimum 18 feet
- Exceptional 17 feet

3.4.3.3 Inter Track Screen Walls

At locations where screen walls are required, walls shall be constructed to protect passenger and patrons at station platforms from the effects of noise and aerodynamic forces caused by passing trains.

3.5 ACCESS CONTROL AT OTHER LOCATIONS

3.5.1 End of Line and Storage Tracks

End of line tracks and end of storage tracks that extend from the station tracks shall be protected with AR fencing located at:

- One (1) foot minimum distance from the HST right-of-way line in the direction parallel to the tracks, and
- Two (2) feet minimum distance from the right-of-way side of the bumping structure in the direction perpendicular to the tracks.

3.5.2 Highway Overpasses Crossing HST Trackway

Where HST trackway is traversed by a motor vehicle overpass, the overpass shall be provided with a combination of rigid traffic barrier and AR fencing. In addition, a solid barrier shall be installed on top of traffic barriers and secured to the AR fencing above the HST trackway to prevent people from coming in contact with OCS wires.

AR fencing at highway overpasses shall be constructed with a curved top to prevent the throwing of objects onto HST trackway.

3.5.3 Streets Dead-Ending at HST Trackway

A rigid traffic barrier shall be installed at the end of dead-end streets, cul-de-sacs or "T" intersections, adjacent to at-grade segments of HST trackway. The barrier length shall be

sufficient to intercept all possible vehicular paths from within the traveled way of the approaching street.

Case 1: Where the longitudinal grade of the streets dead-ending at HST trackway is two (2) percent going down towards HST property, the barrier shall be a minimum of 3 feet 5 inches above the street surface at the barrier.

Case 2: Where steep grades and close proximity of the track require a substantial physical barrier against runaway vehicles, the barrier shall consist of an 18-inch-thick reinforced concrete wall. The top of the barrier shall be six (6) feet above the street surface at the barrier.

3.5.4 Access Roads

Access roads are roads connecting public streets to access gates located along the perimeter fencing of HST trackway, traction power housing and other facilities.

Access roads do not need to be protected with fence. Semi-flexible traffic barriers shall be installed on access roads at the outside of any curve and other locations where the barrier is not required to prevent vehicular entry upon the trackway and where safety considerations dictate a speed less than the posted maximum street speed.

3.5.5 Maintenance Roads

Maintenance roads are roads generally located within HST right-of-way for the purpose of inspecting, servicing and maintaining HST properties.

Maintenance roads do not need to be fenced. If safety conditions along areas of HST maintenance roads dictate installation of traffic barriers, semi-flexible traffic barriers shall be installed, provided that the location of such barriers do not obstruct the clear pathway from walkways to emergency exits or encroach into the clearance envelope of any HST facility.

3.5.6 Emergency Exits and Equipment Rooms in Tunnels

Emergency exits, rooms containing fixed equipments, corridors, stairwells and other controlled areas in tunnels shall have doors and/or gates with a lock system capable of preventing unauthorized access from outside and a release mechanism that makes it possible to open them from the inside for evacuation purposes.

3.5.7 Drainage Structures

Where drainage requires passage under fenced areas of HST properties it shall be achieved using enclosed pipe or culverts. Open ditches crossing under fenced property of the HST are not permitted.

HST trackway over culvert structures shall be protected with AR fencing. Culverts connected to open channels where there may be risk of access to the underside of HST trackway shall be protected with grates installed upstream and downstream at the culvert headwalls. Grates shall have bars spaced six inches apart and shall be strong enough to withstand maximum impact from largest expected floating debris.

4.0 SUMMARY AND RECOMMENDATIONS

Access control fencing, walls and barriers used to protect HST properties must be designed and constructed to effectively prevent unauthorized personnel, vehicles and animals from entering the HST trackway and facilities.

The HST right-of-way shall be fully fenced on its perimeter.

Right-of-way fencing is classified as Access Restricting (AR) fence and Access Detering (AD) fence. AR fence is eight (8) feet high and contains one foot of barbed wire on top. AR fence is recommended for areas that are vulnerable to trespassers. AD fences are six (6) feet high and are recommended for areas determined to be of low intrusion risk. When appropriate, a combination of retaining walls and fences or traffic barriers and fences are recommended for additional protection.

Pedestrian and vehicular gates are recommended along both sides of the trackway at half mile intervals. Swinging gates must open to the outside of the HST property.

Permanent fencing shall be bonded and grounded to prevent electric shock from induced voltage. Warning signs shall be placed at 500 feet intervals along perimeter fencing and gates to warn potential trespassers of the risk of electric shock associated with high voltage lines present in the HST right-of-way.

Tables 4-1 and 4-2 summarize the recommended use of fencing, gates and walls to control access to CHSTP property.

Table 4-1 – Access Control Fencing

HST Location	Fence Type		Walls / Barrier, Other
	AR	AD	
HST Trackway			
At-grade	✓		
At-grade adjacent to Roadways	✓		✓ ⁽¹⁾
At-grade within Highway Corridor	✓		
At-grade adjacent to Conventional Railroad			✓ ⁽¹⁾
At-grade through High Risk Trespassing Areas	✓		
Sloped Cut or Fill (Embankment) Section	✓		
Aerial structure	✓		
Retained Fill	✓		✓
Retained Cut (Open)	✓		✓
Underground (Bored, Mined and Cut and Covered Tunnels)	✓		
HST Facilities			
Yard and Maintenance Facilities	✓		
Signal and Traction Power Facilities	✓		
Passenger Stations	✓		
• Limits of Platforms		✓	
• Inter-Track Fencing / Screen Walls		✓	✓
Parking Structures		✓	
Other Locations			
End of Line and Storage Tracks	✓		

On Highway Overpasses Crossing HST	✓		✓
Streets Dead-Ending at HST Trackway			
• HST trackway is 2% going down towards HST property		✓	✓
• Steep grades and close proximity of the track		✓	
Access Roads			✓
Maintenance Roads			✓
Emergency Exits and Equipment Rooms			✓
Drainage Structures			✓

Table 4-2 – Access Control - Gates

Type of HST Trackway	Gates
At-Grade, Un-retained Fill and Un-retained Cut	5 miles (nominal)
Aerial	5 miles (nominal)
Retained Fill (Embankment) or Retained Cut	5 miles (nominal)

⁽¹⁾ Use of walls and barriers for intrusion protection shall be made in conjunction with site-specific risk assessment.

5.0 SOURCE INFORMATION AND REFERENCES

The following documents were reviewed and in many cases used as guidance during the preparation of this Technical Memorandum.

1. 49 CFR Part 213 – Track Safety Standards
2. CPUC GO 95 – Rules for Overhead Electric Line Construction.
3. CPUC GO No. 26-D – Regulations Governing Clearances on Railroads and Street Railroads with Reference to Side and Overhead Structures, Parallel Tracks, Crossings of Public roads, Highways, and Streets.
4. CPUC GO No. 75-D – Regulations Governing Standards For Warning Devices For At-Grade Highway-Rail Crossings In The State Of California.
5. CPUC GO 143.B – Safety Rules and Regulations Governing Light Rail Transit.
6. The Manual for Railway Engineering of the American Railway Engineering and Maintenance of Way Association (AREMA) Manual 2008.
7. National Fire Protection Association (NFPA) 130
8. California Department of Transportation (Caltrans), Highway Design Manual
9. Caltrans Standard Plans (2006)
10. Bay Area Rapid Transit (BART) Facilities Standards Release – R2.0 (2008)
11. Metropolitan Atlanta Rapid Transit Authority (MARTA) Design Criteria (1997)
12. The DOT and FRA study on intrusion protection entitled, “Safety of High Speed Guided Ground Transportation Systems” (SHSGGTS) November 1994
13. Technical Guidebook GEFRA 2004: technical guidance from National French Railways about twinning between high speed train and road or highway infrastructures
14. UIC Code 777-2: 'Structures Built over Railway Lines – Construction in the Track Zone', this code identifies a 'danger zone' within proximity of the rail, inside which it is preferable to avoid having supports
15. SNCF: Human Resources Rule 0350 (RH0350) – Safety Book for People Working on or Around High Speed Rail Lines.
16. Report of the Joint Study for California High Speed Train 2009 – Ministry of Land, Infrastructure, Transport and Tourism Japan Railway Construction, Transport and Technology Agency.
17. CHSTP System Requirement TUN 4-02.11 Access for rescue services in Tunnels.
18. CHSTP System Requirement TUN 4-02.2 Prevention of unauthorized access to emergency exits and equipment rooms.
19. CHSTP System Requirement TUN 4-02.6 Facilities for self-rescue, evacuation and rescue in the event of an incident.
20. CHSTP System Requirement INF 3-22 Control of access to or intrusion into HST line installations.
21. ADIF: Project de Construcción: Nuevo Acceso Ferroviario de Alta Velocidad de Levante, Madrid-Castilla La Mancha-Comunidad Valencia-Region de Murcia. Mayo 2006.
22. Working Paper on California High Speed Rail Project by Japan Railway Technical Service (JARTS). July 2007.

6.0 DESIGN MANUAL CRITERIA

6.1 GENERAL

The recommendations for access control to be used for the CHSTP are based on an assessment of relevant federal and state laws, current practice used by other operating HST systems and proven performance of the access control system used by transit service providers in the United States. In particular, the guidelines of transit service providers operating on electrified rail in the state of California were considered to be applicable because these achieve the regulatory requirements of local agencies including the California Public Utilities Commission (CPUC).

In addition the following key considerations have been identified as the basis for establishing emergency and maintenance access requirements to the HST corridor:

- Vehicular access shall be provided at regular intervals.
- Access locations shall be facility driven, i.e., coordinated with the location of wayside facilities requiring access such as interlockings, tunnel portals, tunnel shafts, signal housing, etc.
- Vehicular access shall be provided at stations, traction power substations, maintenance of way facilities, and rolling stock maintenance facilities.
- There shall be no routine maintenance performed within the HST right-of-way during revenue service hours.
- Passenger evacuation from high-speed trains or stations into the HST right-of-way is a last option for emergency response. The assumption is that trains will proceed to the next station or that a rescue train will be used to either push the disabled train or to provide for train to train transfer of passengers.
- Continuous access road, adjacent to the HST right-of-way, is not required to support emergency response or Operational and Maintenance activities.
- In general, access control under aerial HST structures is not required.

6.2 ACCESS CONTROL DEVICES

The entire HST right-of-way shall be protected at the property line with a fence, wall or fence-wall, fence-traffic barrier or wall-traffic barrier combination to prevent unauthorized access by people, vehicles or animals.

6.2.1 Fences

Protection of HST properties by means of fencing shall be done during construction phase by temporary fencing and thereafter by permanent fencing. This document addresses the use and type of permanent fencing.

Permanent fencing to be used as follows:

- Access Restriction (AR) Fencing
- Access Deterring (AD) Fencing

6.2.1.1 Access Restriction (AR) Fencing

AR fencing is permanent fencing used to deny access to the HST trackway and to protect HST system property which requires a high degree of security. AR fencing is also used on areas where the risk of trespassing is high and the consequences may result in injury to trespassers and impact on HST operation.

AR fences shall meet the following minimum material and height requirements. Alternative, fencing material can be used as long as it meets or exceeds these minimum requirements and upon approval from the Authority or its representative.

Fencing shall extend from ground level to a minimum height of eight (8) feet, consisting of minimum seven (7) feet of galvanized steel woven mesh or links (commonly known as chain link or cyclone fencing) secured at the top and bottom to galvanized pipe railing, topped by three strands of barbed wire, twelve (12) inches high.

The barbed wire extension arm shall be placed inclined at a 45 degree angle away from HST property. In areas where, due to right-of-way, clearance or other restriction, if the barbed wire arm cannot be placed at a 45 degree angle, it can be placed vertical.

Fence posts shall be cast into concrete footings (Figure 6-1), set into concrete retaining walls or set in rigid traffic barriers. Where a change in direction in the line of fence is five degrees or more, corner posts shall be installed and braced as shown in Figure 6-2.

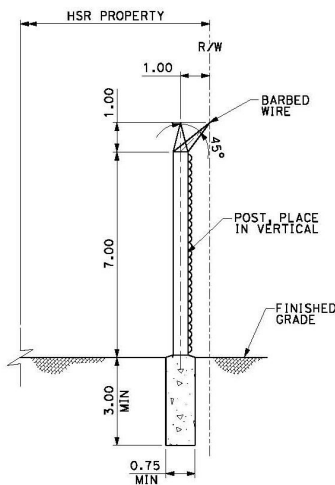


Figure 6-1 – Fence Post

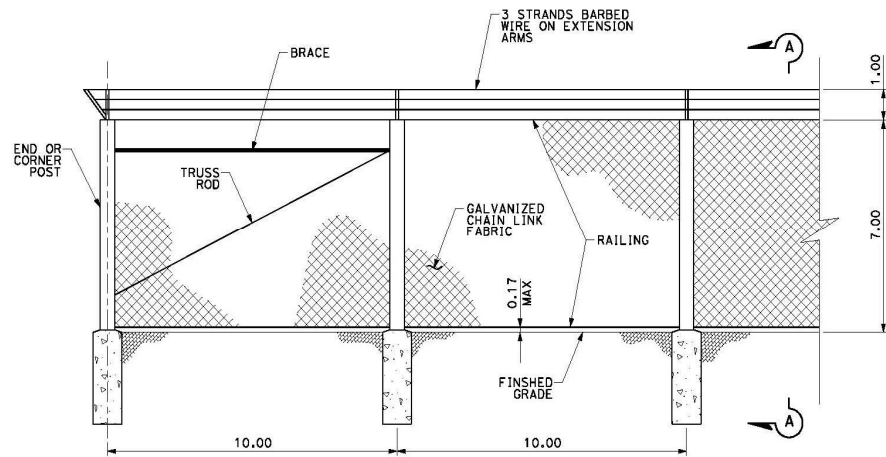


Figure 6-2 – Access Restriction (AR) Fence

AR fences shall be located inside HST right-of-way within a distance of one (1) foot from the right-of-way line with the barbed wire extension arms inclined away from the HST property (Figure 6-1).

Combinations of walls or barriers with chain link fabric and barbed wire with a total height of eight (8) feet measured from the highest ground surface adjacent to the fence or barrier can also be used as AR fencing.

6.2.1.2 Access Detering (AD) Fencing

AD fencing is permanent fencing used to deter access and/or prevent from passing through to areas that do not require a high degree of security. AD fences can also be used in areas where the risk of trespassing is low, such as along viaducts or where trespassing will not result in injuries to trespassers or cause operational impact. AD fencing shall be six (6) feet high, consisting of six (6) feet of chain link fabric, secured at the top and bottom to galvanized pipe railing and no barbed wire. Fence posts shall be cast into concrete footings, set into concrete retaining walls or set in rigid traffic barriers.

6.2.1.3 Grounding of Fencing

Permanent fencing shall be bonded and grounded to prevent electric shock from induced voltage. Refer to TM 3.2.6 for additional details on the requirements for grounding of fences.

6.2.2 Walls

Walls may be used to prevent intrusion by vehicles into HST property. When appropriate, walls may be used in combination with fences at the following locations:

- Where there is vertical separation
- Where there is close proximity between the HST trackway and an adjacent transportation facility
- Between through tracks and station tracks to protect passengers and patrons at station platforms from the effects of noise and aerodynamic forces caused by passing trains.

6.2.3 Traffic Barriers

Traffic barriers may be required where the HST right-of-way abuts public and private roads and highways and at highway overpasses where there is a potential of vehicles accidentally entering the HST right-of-way. Traffic barriers used to protect HST trackway shall be Caltrans Standard traffic barrier of the following types:

- Rigid Traffic Barrier:** shall be used where HST trackway is in close proximity to freeway traffic lanes and/or the travelled way of any adjoining roadway. Rigid traffic barriers shall be Caltrans Concrete Barrier of 3 to 5 feet height as required for the roadway traffic conditions (i.e., speed, number of trucks, etc) and location (i.e., on steep slope, along small radii curves etc.). Rigid traffic barriers shall be used in conjunction with AR fences to prevent intrusion into HST trackway from adjacent roadways. Design and construction details for Caltrans Concrete Barriers of the various types can be found in Caltrans Standard Plans.
- Semi-flexible Traffic Barrier.** Shall be used along service and maintenance roads located within HST right-of-way except when such roads are located in close proximity to any track in which the placement of barriers may compromise the trackway clearance envelope. Semi-flexible barriers shall be placed at the outside of curve as required by safety considerations, to delineate the roadway and maintain vehicles within the roadbed. Semi-flexible traffic barriers shall be Caltrans Metal Beam Guard Railing of the appropriate type for the local condition. Design and installation details for Metal Beam Guard Railing can be found in Caltrans Standard Plans.

6.2.4 Fencing and Traffic Barriers in Combination

AR fencing shall be located preferably three (3) feet or more from the back side of a semi-flexible traffic barrier. Where three (3) feet separation cannot be achieved, a rigid traffic barrier shall be used and fence height shall be increased by a height equal to the height of the barrier. Where AR or AD fencing is installed on top of a rigid barrier the combined height of fence and barrier shall be not less than 7'-0".

6.2.5 Gates

- Gates with locking devices shall be provided along fenced areas to allow access to authorized personnel, emergency vehicles, and maintenance equipment.
- Gates shall be constructed of the same material and height as adjacent fence and shall not decrease the level of security provided by the fences.
- Gates for personnel and equipment access (walking gates) shall have a minimum width of four (4) feet.
- Gates for vehicular access (driving gates) shall be sized in coordination with emergency responders and maintenance equipment. If no other information is available these gates should have a minimum width of twelve (12) feet.
- Gates along right-of-way fencing may require approval by the local fire protection agency.
- Gates may be either swinging or sliding type. Driving swinging gates shall be a pair and shall be hinged from the inside. Provision shall be made for swinging gates to swing not less than 90 degrees away from HST facilities.
- Driving gates shall be provided in conjunction with either access roads or at locations where existing roads make it practicable for emergency vehicles to get to the trackway.

- h) Gate locations along fencing within freeway right-of-way will require Caltrans approval.
- i) Gate locations shall be coordinated with (i.e., placed adjacent to or near) the location of HST wayside facilities requiring access from outside HST right-of-way.
- j) Along at-grade trackway, driving gates shall be located at approximately five (5) mile intervals on either right-of-way side. When possible, access gates should be staggered.
- k) At aerial sections, access to the trackway shall be made from stations or by mobile ladder equipment from roadways adjacent to the trackway. If no adjacent or crossing roadways exist, construction of access roads is required. Gates shall be provided along aerial structures at intervals of five (5) miles on either side of the trackway (not on both).

6.2.6 Signage

Fencing shall be provided with signs warning of hazards from HST operations, high voltage electrical installations, and any other relevant hazards, at any location where the public may reasonably be expected to approach the right-of-way.

Signs bearing the words “Danger”, “High Voltage Lines” and “Keep Away” in letters at least three (3) inches in height, shall be installed at intervals of not more than 500 feet along each fence enclosing the rights-of-way, at every gate and at each station or passenger loading platform. The signs may carry other information relative to the hazard present, but the three required phrases (Danger, High Voltage Lines and Keep Away) shall be in type of larger size than the type of the additional items.

Signs bearing the message “No Trespassing” in letters of at least three (3) inches in height, and including the California Penal Code section number for trespassing in smaller letter size, shall be installed at a minimum, every 500 feet, at a height between five (5) and six (6) feet from the finished ground outside CHST property.

Additional guidance on signage will be developed to ensure consistency throughout the HST system.

6.2.7 Vegetation Control

Vegetation along fenced areas of HST property shall be controlled to assure that no large trees or shrubs provide access over the fence by people or animals. Fencing and trees shall be kept apart a minimum of five (5) feet. Tree branches shall be kept five (5) feet away from any electrical lines that supply power to the HST system to prevent squirrels and other animals from accessing the electric lines. Future growth of vegetation shall be considered when planning new landscaped areas.

6.3 ACCESS CONTROL BY TYPE OF HST TRACKWAY

Access to non-public HST property shall be controlled by installing perimeter fences along the right-of-way with locked gates to allow access and egress of maintenance and emergency personnel. Within the vicinity of a passenger station the right-of-way fencing shall be installed to prevent any unsafe shortcut to the platform and to guide the passengers to the designated platform entrances.

Access into the area of operating infrastructure may be protected with fences equipped with intrusion detection devices to alert of unauthorized entry.

6.3.1 At-Grade Trackway

AR fencing as described above shall be provided continuously along each side of at-grade HST trackway sections, including transitions to underground or aerial sections. Fence construction shall be designed, installed and maintained in such manner as to deny access over, under or through the fencing to unauthorized persons. The HST system shall have no at-grade public road crossings or at-grade crossings of other rail systems.

AR fences shall be located at one (1) foot minimum distance within the HST right-of-way line.

6.3.2 At-Grade Trackway within Highway Corridor

A combination of AR fence and an appropriate rigid traffic barrier shall be constructed along the HST right-of-way when it is at-grade, runs parallel and is adjacent to a highway traffic lane, including locations where the trackway shares a common corridor in a highway median.

The AR fence shall be located inside HST right-of-way at a minimum distance of one (1) foot from the HST right-of-way line. The traffic barrier shall be located within the highway right-of-way, as close as possible to the highway edge of travel lane or at a minimum distance of three (3) feet from the AR fence. The traffic barrier shall have a minimum height of 4'-6" above the highway grade level.

6.3.3 At-Grade Trackway Adjacent to Conventional Rail Transportation Systems

Protection against accidental intrusion from adjacent transportation facilities shall be provided where a HST trackway is in close proximity to a corridor with another mode of transportation.

The preferred form of intrusion protection is adequate lateral separation. Where adequate lateral separation cannot be achieved, consideration can be made for a berm, a ditch or a physical barrier that will effectively prevent intrusion by an out-of-control vehicle from an adjacent transportation right-of-way.., Design and location of physical intrusion protection barriers shall be made in conjunction with site-specific risk analysis.

6.3.4 At-Grade Trackway through High-Risk Trespassing Areas

Special consideration shall be given to areas determined to have a high-risk of trespass such as, but not limited to, HST trackway adjacent to parks, playgrounds, schoolyards, highly populated urban areas or areas within the pathway to and from any of these places, which require a higher degree of security. An eight (8) foot high, AR type fence fabricated of a stronger material which offers higher anti-climbing and cutting-detering levels may be required at these locations. In addition, the surface under the fence may be paved to prevent undermining.

6.3.5 Trackway in Cut or Fill (Embankment) Section

AR fencing shall be used for HST trackway along embankment and cut sections. AR fences shall not be placed on the slope surfaces of the cut or embankment sections.

When the HST trackway section is in cut, AR fences shall be located at a distance from the top of slope

- Desirable 10 feet
- Minimum 3 feet
- Exceptional 1 foot

When the HST trackway section is on embankment, AR fences shall be located at a distance from the toe of slope:

- Desirable 10 feet
- Minimum 3 feet
- Exceptional 1 foot

6.3.6 Trackway on Aerial Structure

- a) At abutments of aerial structures, AR fencing from adjoining sections shall be continued beyond the abutment to a point where the soffit of the structure is ten (10) feet or more above the natural ground line. At that point, the right-of-way fences on each side of the aerial structure shall be joined under the aerial structure.
- b) Where the ground level is less than ten (10) feet below the underside of the structure, aerial structure sections shall be protected with AR fencing located two (2) feet from the drip-line of the structure. Fencing is not required under an aerial structure where the right-of-way adjoins property which is already fenced in a manner consistent with these criteria.

- c) Where right-of-way for aerial structure abuts public property, fencing will not be required except at abutments.
- d) Emergency access to the trackway shall be from stations or by mobile ladder equipment from roadways. If no adjacent or crossing roadways exist, access at maximum 5 mile intervals shall be provided.
- e) Access to the structure shall be maintained for inspection and maintenance. The super structure shall remain accessible longitudinally for five (5) feet outside of the structure drip line for purposes of inspection and emergency access.
- f) Area around the columns and foundations should remain accessible for ten (10) feet (minimum) outside of the foundation limits.
- g) It generally is not required to control access under viaduct structures.
- h) Security in specific areas shall be enhanced if found to be problematic or if anticipated to be an area of concern.

6.3.7 Trackway on Retained Fill

Retained fill trackways have at least one vertical wall exceeding five (5) feet in height measured from finished surface along the non trackway side of the wall.

- a) AR fencing shall be installed on top of retaining walls along retained fill sections on the following conditions:
 - When retaining walls are located at the right-of-way line along HST trackway and the adjacent land outside HST property is less than ten (10) feet below the top of the wall.
 - When the concrete barriers are located on the right-of-way line, adjacent to a HST trackway.
 - The combined height of the wall or traffic barrier and fence above the adjacent ground outside the HST right-of-way shall be not less than eight (8) feet, including wall, chain link fabric and one (1) foot of barbed wire.
- b) Where a retaining wall is well within the right-of-way line, security fencing shall be located in accordance with other requirements and shall not be placed on top of the wall. Railing may be required along the top of wall.
- c) Fencing between at-grade and retained fill sections shall be continuous.
- d) Where a retaining wall is used as support for both fencing and poles supporting lights, OCS or signs, the open space between the fence and the pole shall be less than four (4) inches.
- e) Emergency access to retained fill trackway shall be from stations or by mobile ladder equipment from nearby roadways. If no adjacent or nearby roadways exist, access roads shall be constructed in coordination with the locations of wayside facilities requiring access or at not more than five (5) mile intervals.

6.3.8 Trackway on Retained Cut (Open)

Retained cut trackways are defined as trackways having at least one of its vertical walls exceeding five (5) feet in height measured from the top of rail.

- 1. AR fencing shall be installed on top of retaining walls or rigid traffic barriers along retained cut sections on the following conditions:
 - When retaining walls are located at the right-of-way line along HST trackway and the adjacent land outside HST property is less than ten (10) feet above the top of the wall.
 - Concrete barriers located adjacent to a HST trackway on the right-of-way line.

The combined height of the wall or traffic barrier and the fence above the adjacent ground outside the HST right-of-way shall be not less than eight (8) feet, including wall, chain link fabric and one (1) foot of barbed wire.

2. Where a retaining wall is well within the right-of-way line, security fencing shall be located in accordance with other requirements and shall not be placed on top of the wall. Railing may be required along the top of wall.
3. Fencing between at-grade and retained sections shall be continuous.
4. Where a retaining wall is used as support for both, fencing and poles supporting lights, OCS or signs, the open space between the fence and the pole shall be less than six (6) inches.

6.3.9 Trackway Underground (Bored, Mined and Cut and Covered Tunnels)

- Where at-grade sections adjoin underground sections, the right-of-way AR fencing shall extend beyond the portal by a minimum of 30 feet where possible and be continuous across the right-of-way at that point.
- Where the minimum of 30 feet cannot be achieved because of physical constraints or an adjacent public way, the fencing shall extend across the right-of-way at the point of constraint.
- HST property above underground sections of HST trackway shall be protected in accordance with these criteria and the facility and/or use of the land above ground. If the use of the land above ground has not been defined and no facility has been constructed, perimeter AD fencing with gates is recommended to prevent undesirable use of the property.

6.4 ACCESS CONTROL BY TYPE OF FACILITY

This section prescribes right-of-way fencing for wayside facilities such as yards, maintenance facilities, signaling and traction power facilities.

6.4.1 Yards and Maintenance Facilities

AR fencing with vehicular and pedestrian access gates equipped with locking devices shall be installed along the perimeter of HST yards and shops.

6.4.2 Overhead Catenary System, Signal and Traction Power Facilities

Signal housing, power supply substations, train control, communications equipment and switching and paralleling stations must be either fenced with AR fencing or a nine (9) foot high wall enclosure with secured gates.

Where there is public access or trespass is likely, anti-climbing protection shall be provided at buildings and other structures supporting energized parts of the OCS. The anti-climbing protection should include signs warning of the dangers of high voltage. Access to fixed ladders, particularly at signal poles and signal gantries, and the means of access to any roof or other place which could allow non-authorized persons to approach energized parts, shall be secured or otherwise protected.

6.4.3 Passenger Station

Perimeter AR fence shall be installed along the right-of-way within the vicinity of a station platform to prevent unsafe shortcuts to the platform and to guide passengers to the designated platform entrances.

6.4.3.1 Limits of Platforms

AD type fences with locked gates shall be installed at the ends of station platforms, along the sides of platforms perpendicular to the tracks, to prevent unauthorized access to the trackway.

6.4.3.2 Inter Track Fencing

Inter-track fences shall be provided between through track and station track or between adjacent tracks at station platforms for the full length of the platforms and at least 150 feet beyond each platform end. Inter-track fence shall be AD type or better, 6'-0" height to discourage climbing and prevent people from passing through. Track spacing in the vicinity of inter-track fence shall be:

- Desirable 18 feet
- Minimum 18 feet
- Exceptional 17 feet

6.4.3.3 Inter Track Screen Walls

At locations where analysis determines that screen walls are required, walls shall be constructed to protect passengers and bystanders at station platforms from the effects of noise and aerodynamic forces caused by passing trains.

6.5 ACCESS CONTROL AT OTHER SPECIAL LOCATIONS

6.5.1 End of Line and Storage Tracks

End of line tracks and end of storage tracks that extend from the station tracks, shall be protected with AR fencing located at:

- One (1) foot minimum distance from the HST right-of-way line in the direction parallel to the tracks, and
- Two (2) feet minimum distance from the right-of-way side of the bumping structure in the direction perpendicular to the tracks.

6.5.2 Highway Overpasses Crossing HST Trackway

Where HST trackway is traversed by a motor vehicle overpass, the overpass shall be provided with a combination of rigid traffic barrier and AR fencing. In addition, a solid barrier shall be installed on top of traffic barriers and secured to the AR fencing above the HST trackway to prevent people from reaching out and contacting the OCS wires.

AR fencing at highway overpasses shall be constructed with a curved top to prevent the throwing of objects onto CHST trackway.

6.5.3 Streets Dead-Ending at HST Trackway

A rigid traffic barrier shall be installed at the end of dead-end streets, cul-de-sacs or "T" intersections, adjacent to at-grade segments of HST trackway. The barrier length shall be sufficient to intercept all possible vehicular paths from within the travelled way of the approaching street.

Case 1: Where the longitudinal grade of the streets dead-ending at HST trackway is two (2) percent going down towards HST property, the barrier shall be a minimum of 3 feet 5 inches above the street surface at the barrier.

Case 2: Where steep grades and close proximity of the track require a substantial physical barrier against runaway vehicles, the barrier shall consist of an 18-inch-thick reinforced concrete wall. The top of the barrier shall be six (6) feet above the street surface at the barrier.

6.5.4 Access Roads

Access roads are roads connecting public streets to access gates located along the perimeter fencing of HST trackway, traction power housing and other facilities.

Access roads do not need to be protected with fence. Semi-flexible traffic barriers shall be installed on access roads at the outside of any curve and other locations where the barrier is not required to prevent vehicular entry upon the trackway and where safety considerations dictate a speed less than the posted maximum street speed.

6.5.5 Maintenance Roads

Maintenance roads are roads generally located within HST right-of-way for the purpose of inspecting, servicing and maintaining HST properties.

Maintenance roads do not need to be fenced. If safety conditions along areas of HST maintenance roads dictate installation of traffic barriers, semi-flexible traffic barriers shall be installed, provided that the location of such barriers do not obstruct the clear pathway from walkways to emergency exits or encroach into the clearance envelope of any HST facility.

6.5.6 Emergency Exits and Equipment Rooms in Tunnels

Emergency exits, rooms containing fixed equipments, corridors, stairwells and other controlled areas in tunnels shall have doors and/or gates with a lock system capable of preventing unauthorized access from outside and a release mechanism that makes it possible to open them from the inside for evacuation purposes.

6.5.7 Drainage Structures

Where drainage requires passage under fenced areas of HST properties it shall be achieved using enclosed pipe or culverts. Open ditches crossing under fenced property of the HST are not allowed.

HST trackway over culvert structures shall be protected with AR fencing. In addition, culverts connected to open channels where there may be risk of access to the underside of HST trackway shall be protected with grates installed upstream and downstream at the culvert headwalls. Grates shall have bars spaced six inches apart and shall be strong enough to withstand maximum impact from largest expected floating debris.

6.6 ACCESS CONTROL SUMMARY

Access control fencing, walls and barriers used to protect HST properties shall be designed and constructed to effectively reduce the risks associated with unauthorized personnel, vehicles and animals trespassing into the HST corridor.

The HST right-of-way shall be fully fenced on its perimeter.

Right-of-way fences are classified as Access Restricting (AR) fences and Access Deterring (AD) fences. AR fences are eight (8) feet high and contain one (1) foot of barbed wire on top. AR fences are recommended for areas that are vulnerable to trespassers. AD fences are six (6) feet high and are recommended for areas determined to be of low intrusion risk. When appropriate, a combination of retaining walls and fences or traffic barriers and fences are recommended for additional protection.

Pedestrian and vehicular gates are recommended along both sides of the trackway at half mile intervals. Swinging gates must open to the outside of the HST property.

All fences and gates must be grounded to prevent electric shock. Warning signs must be placed at 500 feet intervals along perimeter fencing and gates to warn potential trespassers of the risk of electric shock associated with high voltage lines present in the HST right-of-way.

Tables 6-1 and 6-2 summarize the recommended use of fencing, gates and walls along California High-Speed Train properties.

Table 6-1 – Access Control Fencing

High-Speed Train Infrastructure	Fence Type		Walls / Barrier, Other
	AR	AD	
HST Trackway			
At-grade	✓		
At-grade adjacent to Roadways	✓		✓ ⁽¹⁾
At-grade within Highway Corridor	✓		
At-grade adjacent to Conventional Railroad			✓ ⁽¹⁾
At-grade through High Risk Trespassing Areas	✓		
Sloped Cut or Fill (Embankment) Section	✓		
Aerial structure	✓		
Retained Fill	✓		✓
Retained Cut (Open)	✓		✓
Underground (Bored, Mined and Cut and Covered Tunnels)	✓		
HST Facilities			
Yard and Maintenance Facilities	✓		
Signal and Traction Power Facilities	✓		
Passenger Stations	✓		
• Limits of Platforms		✓	
• Inter-Track Fencing / Screen Walls		✓	✓
Parking Structures		✓	
Other Locations			
End of Line and Storage Tracks	✓		
On Highway Overpasses Crossing HST	✓		✓

Streets Dead-Ending at HST Trackway • HST trackway is 2% going down towards HST property		✓	✓
• Steep grades and close proximity of the track		✓	
Access Roads			✓
Maintenance Roads			✓
Emergency Exits and Equipment Rooms			✓
Drainage Structures			✓

⁽¹⁾ Use of walls and barriers for intrusion protection shall be made in conjunction with site-specific risk assessment.

Table 6-2 – Access Control - Gates

Type of HST Trackway	Gates
At-Grade, Un-retained Fill and Un-retained Cut	5 miles (nominal)
Aerial	5 miles (nominal)
Retained Fill (Embankment) or Retained Cut	5 miles (nominal)

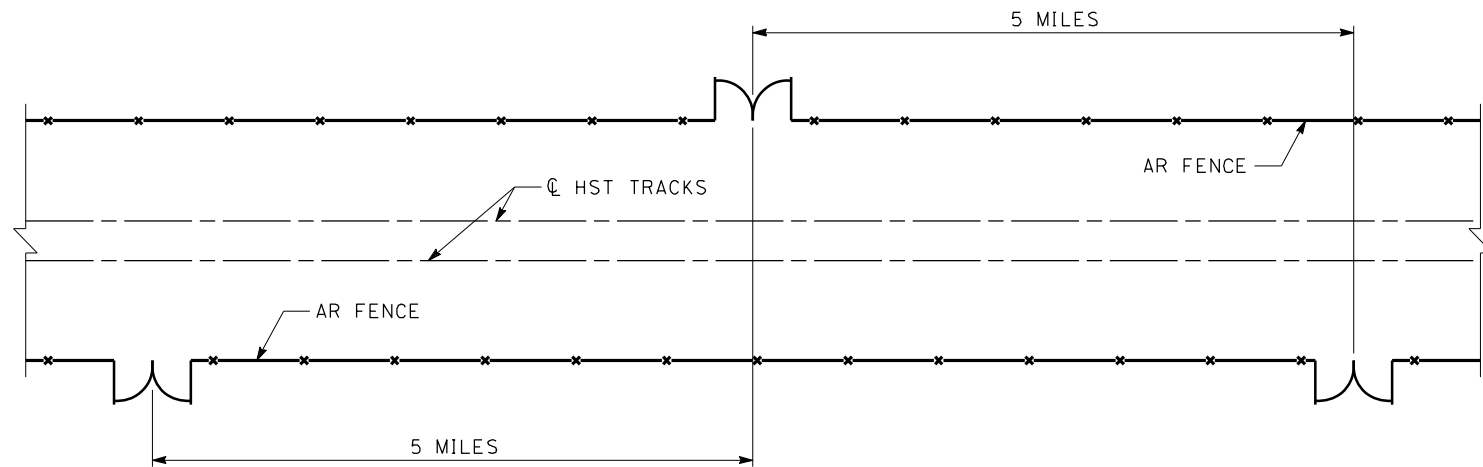
APPENDICES

APPENDIX A: REGULATIONS AND INDUSTRY STANDARDS ON ACCESS CONTROL FOR TRACKWAY AND FACILITIES

APPENDIX B: ASSESSMENT OF CURRENT PRACTICE ON ACCESS CONTROL FOR TRACKWAY AND FACILITIES

APPENDIX C: SUMMARY OF RECOMMENDATIONS ON ACCESS CONTROL FOR HST RIGHT-OF-WAY AND FACILITIES

10/8/2010 10:42:11 AM T:\13259B Calif High Speed Rail\CADD\Directive Drawings\2.8.2 - Access Control\2.8.2-B.dgn



**GATE LOCATIONS ALONG HST TRACKWAY
(AT GRADE)**

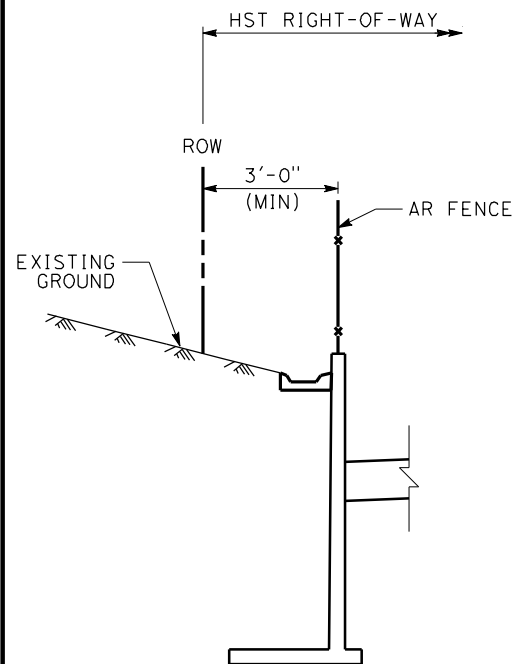
LEGEND:



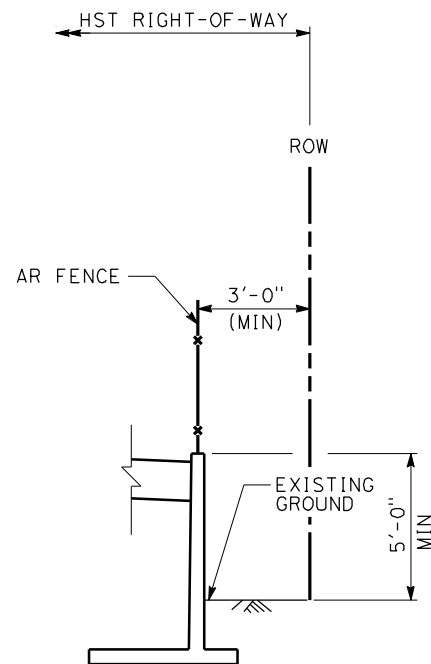
VEHICULAR ACCESS GATE

NOTES:

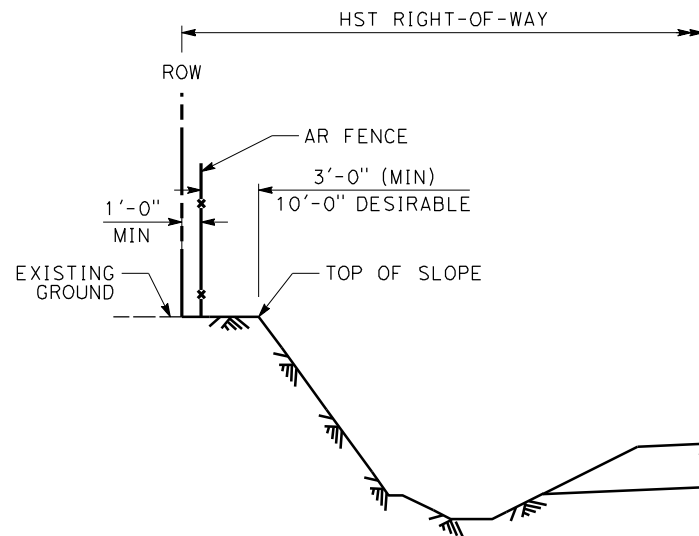
1. GATES SHALL BE CONSTRUCTED OF THE SAME MATERIAL AND HEIGHT AS ADJACENT FENCE AND SHALL NOT DECREASE THE LEVEL OF SECURITY PROVIDED BY THE FENCE.
2. GATES FOR PERSONNEL AND EQUIPMENT ACCESS (WALKING GATES) SHALL HAVE A MINIMUM WIDTH OF FOUR (4) FEET.
3. GATES FOR VEHICULAR ACCESS (DRIVING GATES) SHALL BE SIZED IN COORDINATION WITH EMERGENCY RESPONDERS AND MAINTENANCE EQUIPMENT. IF NO OTHER INFORMATION IS AVAILABLE THESE GATES SHOULD HAVE A MINIMUM WIDTH OF TWELVE (12) FEET.
4. GATES ALONG RIGHT-OF-WAY FENCING MAY REQUIRE APPROVAL BY THE LOCAL FIRE PROTECTION AGENCY.
5. GATES CAN BE EITHER SWINGING OR SLIDING TYPE. DRIVING SWINGING GATES SHALL BE A PAIR AND SHALL BE HINGED FROM THE INSIDE. PROVISION SHALL BE MADE FOR SWINGING GATES TO SWING NOT LESS THAN 90 DEGREES AWAY FROM HST FACILITIES.
6. DRIVING GATES SHALL BE PROVIDED IN CONJUNCTION WITH EITHER ACCESS ROADS OR AT LOCATIONS WHERE EXISTING ROADS MAKE IT PRACTICABLE FOR EMERGENCY VEHICLES TO ACCESS THE TRACKWAY.
7. GATE LOCATIONS ALONG FENCING WITHIN FREEWAY RIGHT-OF-WAY WILL REQUIRE CALTRANS APPROVAL.
8. GATES LOCATIONS SHALL BE COORDINATED WITH (I.E. PLACED ADJACENT TO OR NEAR) THE LOCATION OF HST WAYSIDE FACILITIES REQUIRING ACCESS FROM OUTSIDE HST RIGHT-OF-WAY.
9. ALONG AT-GRADE TRACKWAY, VEHICULAR GATES SHALL BE LOCATED NOMINALLY AT FIVE MILES INTERVALS.



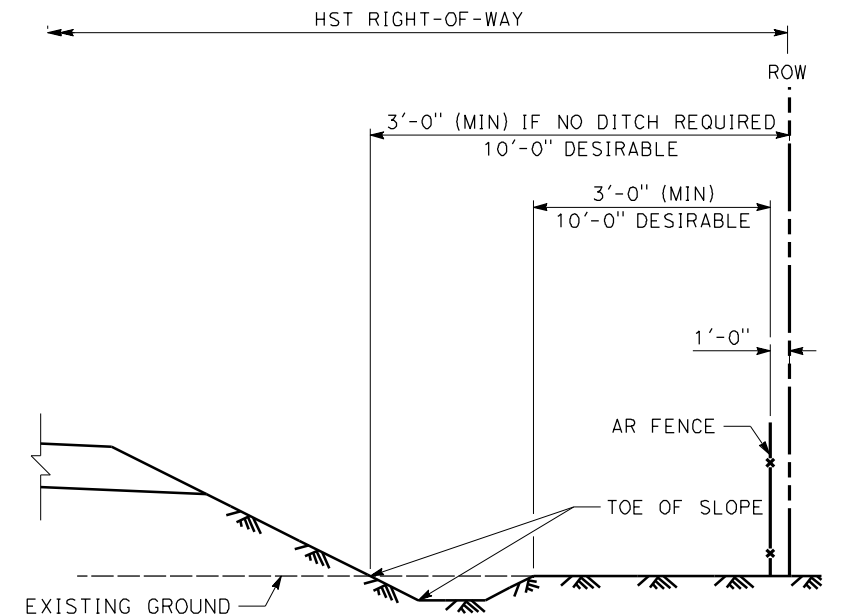
**FENCE LOCATION ALONG
HST TRACKWAY IN RETAINED CUT/
(IN OPEN TRENCH)**



**FENCE LOCATION ALONG
HST TRACKWAY ON RETAINED FILL**



**FENCE LOCATION ALONG
HST TRACKWAY IN CUT SECTION**



**FENCE LOCATION ALONG
HST TRACKWAY ON FILL SECTION**

REV	DATE	BY	CHK	APP	DESCRIPTION

DESIGNED BY M. ACOSTA
DRAWN BY D. SOLTERO
CHECKED BY J. CHIRCO
IN CHARGE K. JONG
DATE 10/06/10

**PARSONS
BRINCKERHOFF**

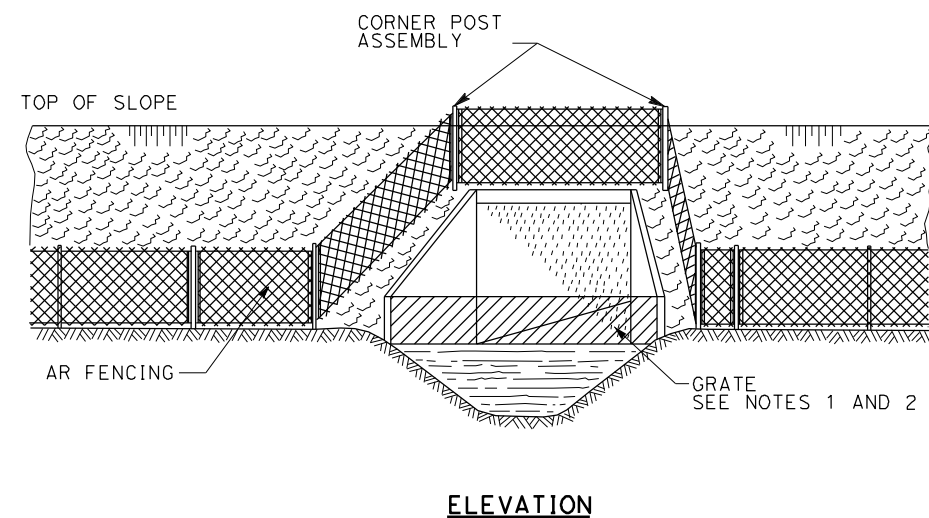
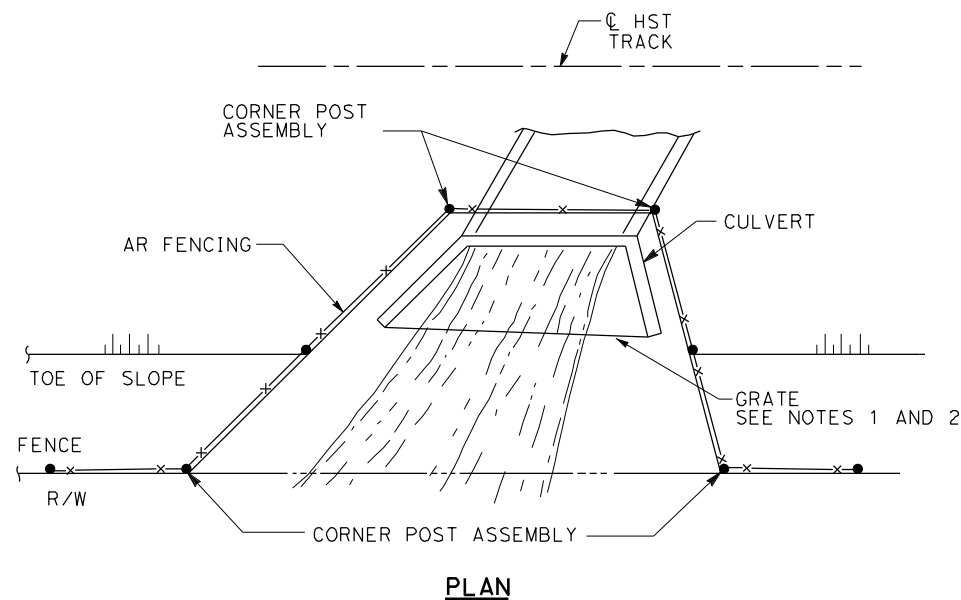


CALIFORNIA HIGH-SPEED RAIL AUTHORITY
FLY CALIFORNIA
Without ever leaving the ground.

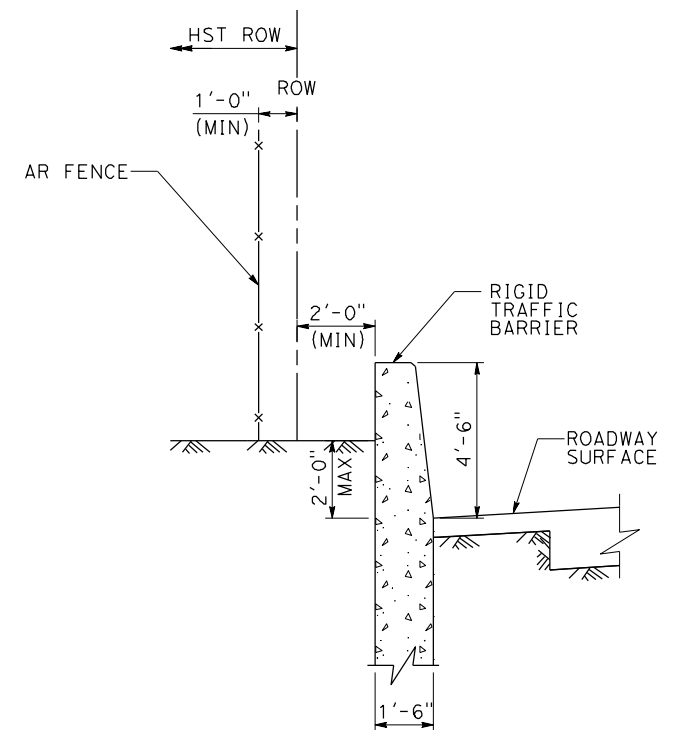
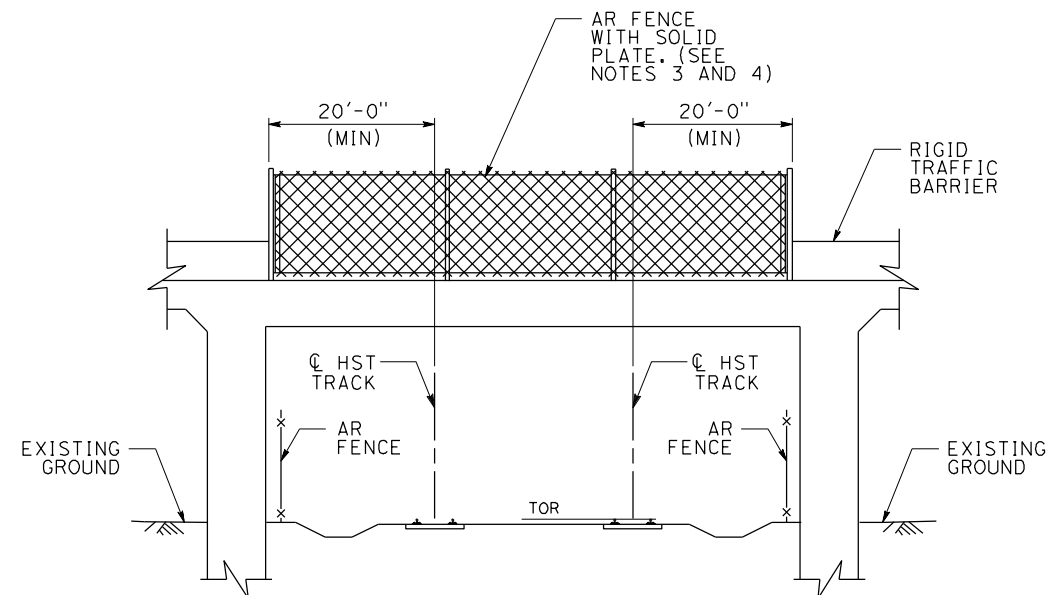
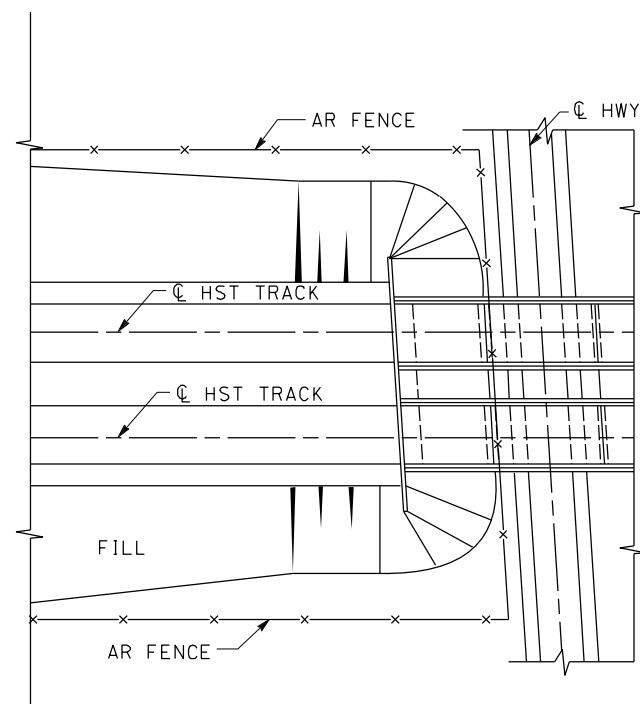
CALIFORNIA HIGH-SPEED TRAIN PROJECT

ACCESS CONTROL
RIGHT-OF-WAY FENCE AND GATES LOCATIONS
1 OF 2

CONTRACT NO. 13259
DRAWING NO. TM 2.8.2-B
SCALE NO SCALE
SHEET NO.



HST TRACK OVER CULVERT STRUCTURE



NOTES:

1. GRATES SHALL BE INSTALLED UPSTREAM AND DOWNSTREAM OF CULVERT HEADWALLS.
2. GRATES SHALL HAVE BARS SPACED SIX INCHES APART AND SHALL STAND ENOUGH TO WITHSTAND MAXIMUM IMPACT FROM LARGEST EXPECTED FLOATING DEBRIS.
3. AR FENCING AT HIGHWAY OVERPASSES SHALL EXTEND 10 FEET MINIMUM FROM LIVE PARTS OF OCS OR 20 FEET MINIMUM FROM CENTERLINE OF HST TRACK WHICHEVER IS GREATER.
4. AR FENCING AT HIGHWAY OVERPASSES SHALL HAVE CURVED TOP TO PREVENT THE THROWING OF OBJECTS ONTO TRACKWAY.

REV	DATE	BY	CHK	APP	DESCRIPTION

DESIGNED BY	M. ACOSTA
DRAWN BY	D. SOLTERO
CHECKED BY	J. CHIRCO
IN CHARGE	K. JONG
DATE	10/06/10



CALIFORNIA HIGH-SPEED RAIL AUTHORITY

CALIFORNIA
Without ever leaving the ground.

CALIFORNIA HIGH-SPEED TRAIN PROJECT

ACCESS CONTROL
RIGHT-OF-WAY FENCE AND GATES LOCATIONS
2 OF 2

CONTRACT NO.
13259

DRAWING NO.
TM 2.8.2-C

SCALE
NO SCALE

SHEET NO.